2009 Delaware State University and University of Delaware Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Delaware agriculture faces a period of transition today unlike any encountered in the past. For decades, and still today, the driving force behind Delaware's agricultural economy has been its highly productive and geographically intensified poultry industry. In 2008, poultry and egg sales ($773M) accounted for ~71% of the total market value of all Delaware agricultural products ($1B). Most of this income was associated with the production and sale of about 246 million broiler chickens. In turn, cropping systems in Delaware have always been influenced by poultry production because of the need of this industry for a large and readily available supply of feed grains. For decades, most of Delaware's cropland has been used for grain crop production; in 2007, corn, soybeans, and small grains represented about 88% of the 455,695 acres of field, hay, and vegetable crops harvested in Delaware and generated $117M in farm sales. Other major economic components of Delaware agriculture in 2007 were vegetables ($71.5M), dairy ($21.7), and the rapidly growing "Green Industry" (nurseries, floriculture, greenhouses, and turf; $17M). Delaware ranks first in the nation with lima bean acres harvested. Today, many economic and social changes are in motion that may significantly alter the face of Delaware agriculture in the future. One of the primary reasons for the long-term success of the poultry industry, and Delaware agriculture in general, has been the proximity of the state to major urban markets, such as Baltimore, Philadelphia, New York, and Washington, D.C. However, recent trends in population growth and mobility in the Northeast and Mid-Atlantic regions have begun to markedly influence the nature of land use in Delaware and raise serious questions about the future role of agriculture in the state's economy. Simply put, there has been a population migration into Delaware from other states in response to economic opportunities, desirable retirement settings, and relatively low housing and land costs. The state population grew by nearly 20% from 1990 to 2000, accompanied by decreases in the number of farms and the amount of land in farms. From 2000 to 2008, the population continued to increase at a rate higher than the US average at 11.4%. Projections show Delaware reaching one million persons by the year 2025. In 2002, there were 2,391 farms with a total of 540,080 acres; by 2007 the number of farms increased to 2,546, however overall farm acreage was reduced to 510,253 acres. Agriculture still remains the dominant land use in Delaware with 40.8% of the state land area. Despite statewide efforts to preserve farmland and natural resource areas, agricultural lands are rapidly being converted into suburban developments, small towns are becoming small cities, and our natural ecosystems are becoming increasingly fragmented. Land use is a politically charged issue, with agriculture firmly in the center of the debate. The value of farmland for development has skyrocketed, and Delaware farmers (average age is 55 and 25% of all principal operators are 65 or older), are regularly offered opportunities to sell their farms for housing, schools, and other urban or suburban land uses. Between 2002 and 2007, farm real estate values more than doubled. The average value per acre increased from $4,054 to $10,347. Clearly, Delaware agriculture must develop a new vision for the future, one that looks to new products and new markets, while integrating innovations in production and marketing into current agricultural systems, if it is to remain a viable segment of the state's economy. Of equal importance is the need to not only sustain, but improve Delaware's natural ecosystems and environment, including wildlife habitats, biodiversity, air, soil, and water quality. Our plan of work is organized into the following nine planned programs intended to provide solutions to the complex challenges facing Delaware today. It is important to note that the divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, often in collaboration with colleagues in other disciplines. We also regularly plan and work with a wide range of stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions.

Animal Biology, Health, and Production Systems:

Our focus is on sustaining animal agriculture as a major economic engine for Delaware agriculture by advancing our understanding of animal genomics, disease diagnosis and control, and innovative, environmentally friendly production practices. Animal-based agriculture is one of the major components of Delaware's economy and has a major impact on the nature of crop production in the state. Poultry production is a three quarter of a billion dollar per year industry and other livestock sales (dairy, beef, swine) account for $26.6 million annually. The animal industries are also the main economic outlet for Delaware grain farmers who each year produce $70 to $80 million in corn, soybeans, and wheat. However, the fastest growing segment of animal agriculture in Delaware is the equine industry. In 2004, there were 13,000 equine at 2000 operations (horses on private farms, small stables, and at racetracks) in Delaware, utilizing 27,000 acres of land. Delaware ranks third in the U.S.A. in the average number of equine per county. The industry has more than a $360 million annual impact to the State, indicating its economic value to Delaware agriculture. Our main research and extension activities in this program are: diagnosis and control of infectious diseases; improved understanding of avian genomics as related to

production and disease; food safety and technology; animal welfare; enhancing the environmental compatibility of animal production with emphasis on nonpoint nutrient pollution, air quality, pathogens, and emerging issues (e.g., arsenic, antibiotics, endocrine disruptors); improving energy efficiency of poultry production by developing solar-powered poultry houses; expanding extension programs in equine health and nutrition; and building better community relations between animal producers and their suburban, non-agricultural neighbors.

In FY2009, there were 32 FTEs (28 research and 4 extension) associated with our *Animal Biology, Health, and Production Systems* planned program. Outputs of this program included 17 awarded grants (of 29 submitted), mentorship of 10 M.S. and 4 Ph.D. graduate students, 31 refereed publications (scientific articles, books, and book chapters), 17 extension fact sheets, 32 invited and 87 volunteered presentations, 2 websites, and 51 workshops. Ongoing projects in these areas involve leadership and active participation in programs of the USDA-CREES sponsored Avian Influenza Coordinated Agricultural Project (AI CAP) with goals to: (i) improve the diagnostic tools needed to rapidly identify and respond to an AI outbreak; (ii) develop depopulation techniques to deal with poultry mortality caused by AI; and (iii) educate the poultry industry, other industries associated with poultry production, state and federal agencies, and the public about preventing and controlling this disease. The UD AI team continues to work closely with the Delaware Department of Agriculture and the Delaware Department of Health and Social Services to coordinate response plans in the event of an AI situation. International efforts include collaborative training sessions on AI prevention, diagnosis and management with scientists from Romania and Bulgaria. Basic research has also focused on other potentially devastating poultry diseases, including Marek's, stunting runting syndrome (Cystic Enteritis), and infectious laryngotracheitis. In FY09, the University of Delaware developed and offered a four day certificate course on Emergency Poultry Disease Response (EPDR). Topics in the course included understanding the influenza virus, surveillance, biosecurity, outbreak response and control, incident command structures, protecting the responder and personal protection, depopulation, disposal and composting, and decontamination. Hands on demonstrations included personal protective equipment, foam depopulation, in house composting, protecting the responder, and disinfection. The program uses a unique model in which grant funding was used to develop the program and the program will transition to a tuition based model. In 2009, 11 participants (10 domestic, 1 international) attended, representing state departments of agriculture, poultry integrators, and allied industries. In a pre-course survey, over half the participants indicated that they were not prepared to respond while, after the course, all participants indicated that they were prepared to respond. Research and extension programs on the quick containment of flocks infected with avian flu are ongoing and expanding internationally. These programs demonstrate partial or whole house containment, or containerized gassing with carbon dioxide. A multidisciplinary team of engineers and poultry scientists at the University of Delaware is pursuing the refinement and adoption of a novel foam depopulation method as a tool for fighting avian influenza. Past research showed that water-based foam was as effective as other currently accepted but that it could be implemented on a larger scale far faster and with fewer people, reducing the risk of human exposure to AI during depopulation events. Poultry genomic research addressed functional mapping of growth regulating genes in broiler chickens and use of an immunogenomics approach to study host innate immunity against intestinal parasites. Research in avian immunology investigated mechanisms that regulate the immune response of broiler chickens to avian pathogens, with emphasis on the histocompatibility complex (MHC), a gene complex whose products restrict T-lymphocyte recognition of foreign antigens. Extension and research programs on the use of solar energy to power poultry houses continued to grow and receive widespread interest by the industry and governmental agencies. Dairy science research focused on use of microbial inoculants and enzymes to stabilize and prolong the quality of silage during fermentation, thereby improving dairy nutrition. In FY2009, research focused on corn silage hybrids and management techniques to improve digestion. For example, the brown mid rib mutant results in corn silage with lower lignin and thus, higher digestibility than normal hybrids. However, the cost of seed and lower yields are trade-offs that must be considered. Whole plant processing, where the corn plant is crushed and rolled, improves starch and fiber digestibility. Another management technique that is being evaluated is high cutting of corn silage or leaving 18-20 inches of stalk in the field rather than the traditional 4 to 6 inches. The logic for this practice comes from the fact that the lower section of the plant stalk is the most highly lignified and thus poorly digested. However, effects on yield drag may offset improvements in digestibility. Studies are also underway evaluating high cutting and interactions with processing and maturity. Molecular techniques are also being used to investigate growth, metabolism, and effectiveness of these organisms. Other applied dairy studies have addressed effects of feed supplements on white blood cell function, evaluating feed supplement effects on post-ruminal fermentation, and evaluating in vitro measures of cow health.

Basic molecular research is studying the genes that control circadian rhythms in dairy cows and how this relates to immune systems, animal productivity and health and also major respiratory diseases of cattle and swine such as viral-bacterial synergy in the lung that predisposes the virus-infected lung to secondary bacterial colonization and infection. Studies with dairy and swine in FY 2009 addressed viral inhibition of T lymphocyte function, direct inhibition of alveolar macrophage and neutrophil effector functions by respiratory viruses.

Biotechnology and Biotechnology-Based Agribusinesses:

The University of Delaware, in conjunction with the state and private industry, has devoted nearly 25 years to the development of research capacity and expertise in basic and applied biotechnology. Areas of existing strength are avian virology, physiology, and genomics and plant molecular biology and plant breeding. In our avian programs, biotechnology is used at the basic level to improve poultry health and immune competence and to understand fundamental mechanisms of

avian diseases. At the applied level, biotechnology efforts are directed toward improving diagnostic testing methods, developing vaccines and other disease control methodologies, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. For plants, basic biotechnology efforts include understanding gene regulation in plants, particularly those associated with RNA turnover or small RNA-mediated gene regulation. Other efforts include understanding disease resistance and signal transduction pathways in plants, understanding nitrogen fixation via the application of molecular and proteomics approaches, and understanding, at the molecular and atomic levels, plant-soil interfacial relations important to nutrient and heavy metal uptake. Key elements of this program include: expanding fundamental, cross-disciplinary research in the avian and plant/soil research areas; applying basic biotechnology research to the development of diagnostic methodologies for plants and animals; investigating new opportunities to apply biotechnology knowledge, such as alternate, bio-based energy sources (e.g., plant species for biofuels) that make economic sense for Delmarva; producing pharmaceuticals, vaccines, nutriceuticals and other products from plants; and a new, high priority - developing biotechnology-based agribusinesses by financial planning, risk management analysis, and evaluation of the marketability and consumer acceptance of biotechnology based products.

In FY2009, there were 22 FTEs (21 research, 1 extension) associated with our *Biotechnology and Biotechnology-Based Agribusinesses* planned program. Outputs of this program included 12 awarded grants (of 40 submitted), mentorship of 18 M.S. and 16 Ph.D. graduate students, 47 refereed publications (scientific articles, books, and book chapters), 18 invited and 22 volunteered presentations, 14 websites, and 7 workshops. Some key recent research efforts in plant molecular biology included studies of micro and small ribonucleic acids in poultry and crops of global importance. Advanced sequencing technologies and high-powered computer-based informatics approaches continue to be used to study how mRNAs encode proteins and small RNAs regulate plant development and responses to stress. Understanding factors controlling the stability of mRNAs in plants has been a major recent focus. The average half-life of an mRNA in plants and other higher eukaryotes appears to be on the order of hours. However, very unstable mRNAs exist that have half-lives on the order of minutes. Unstable mRNAs can be regulated more rapidly than stable mRNAs, and therefore often encode important regulatory proteins that cells need only transiently. Learning how these highly unstable mRNAs are recognized and selectively degraded is a key area of ongoing and future research. Recent studies identified several RNA sequence elements that can act to target transcripts for rapid decay in Arabidopsis and tobacco. The most prominent are the DST element and repeats of the AUUUA motif and found that DST elements are highly conserved in unstable Small-Auxin Up RNAs (SAURs), and their recognition is unique to plants. Investigations into the molecular biology of plant small RNAs were extended into related areas such as analyses of the "epigenome" - a heritable change that is not a result of a change in DNA sequence, but instead a chemical modification of nucleotides in the DNA or its associated proteins. These technologies and approaches are being applied to many plant species, but with a particular emphasis on two of the plant model systems, Arabidopsis and rice. This has led to the creation of databases, and query & analysis tools to enable the use of these data for the scientific community. Other plant biology research focuses on plant disease resistance genes and related sequences. The Nucleotide Binding Site-Leucine Rich Repeat (NBS-LRR) proteins encoded by many resistance genes provide the first line of defense in many specific plant-pathogen interactions. Approximately 150 of these proteins are encoded in the Arabidopsis Col-0 genome; 50 contain an N-terminal coiled-coil (CC) domain and 100 contain an N-terminal Toll-like (TIR) domain. The long-term goal is to understand both the evolution of these genes and the relationship between sequence, structure and protein function. Other research on small RNAs is related to stresses such as drought, temperature and nutrient deprivation and their relationship to the emerging genetic code of *Brachypodium distachyon*, a potential biofuel crop and a valuable functional genomic model for energy crops and temperate grasses. Molecular biology approaches are also being used to sequence small RNAs in *Medicago*, closely related to alfalfa and thus a good model for legumes such as soybeans, to better understand fundamental mechanisms of biological nitrogen fixation and to elucidate how plant cells communicate through plasmodesmata, by identifying the molecular components involved in these processes and investigating their roles in plant growth and development.

Animal molecular biology research is using high throughput sequencing to develop a collection of chicken ESTs which are then used to prepare DNA microarrays for profiling the development of the immune system. Analyses of changes in these profiles during challenges to the immune system are being conducted as a means to predict vaccine efficiency. In addition, the arrays are used for the identification of candidate genes involved in disease resistance. Characterization of microRNAs in gallid herpesvirus infections indicated that they represent a new form of host-parasite interaction. Additionally, analysis of microRNAs encoded by infectious laryngotracheitis virus, a common and important pathogen of commercial chickens determined that the microRNAs encoded by this virus may be to regulate expression of ICP4, a key viral. These microRNAs may function in the regulation of viral latency via an RNA-silencing mechanism. Other ongoing research focuses on the regulation of growth hormone (GH) action in poultry including the identification and characterization of the chicken growth hormone receptor gene, the components of the signaling pathway used by this receptor, and genes regulated by growth hormone. Mutations in the growth hormone receptor gene in sex-linked dwarf chickens have been identified. This dwarf chicken is being used as an experimental model for studying the role of the growth hormone receptor in growth and development and identifying novel genes whose expression is regulated by GH. In addition, protein-protein interaction domains have been identified in one of the signaling molecules that links the receptor to intracellular events. To further understanding of GH signaling, the domain of this protein is being used in the yeast two hybrid system to identify novel components of the signaling pathway. Molecular techniques are also being used to gain a more fundamental understanding

of Marek's disease virus which transforms T lymphocytes in infected chickens. Specific projects are aimed at understanding the functions of viral gene products important for oncogenicity; latency, including studies on the establishment, maintenance, and reactivation of Marek's disease virus from this state; and critical virus-host cell interactions that influence oncogenicity and vaccinal immunity. Viral gene function is being examined by generating loss of function mutants in the genetic background of a highly oncogenic strain of Marek's disease virus.

Ecosystems and Biodiversity:

Our long-term goal is to develop strategies that enhance and restore ecosystems and sustain biodiversity in a state where land use is creating an increasingly fragmented, suburbanized and inhospitable landscape. Key research and extension programs will focus on: learning how to landscape in ways that allow plants and animals to share human dominated spaces; bettering our understanding of how anthropogenic perturbation of natural ecosystems (forests, wetlands, marshes, ponds) affects their ecological functions and the values they provide to society; developing management strategies that improve natural areas (e.g., forests) and native wildlife habitat, protect endangered species, and increase native biodiversity; developing new agricultural management practices for the control of pests and invasive species that have minimal effects on natural ecosystems and environmental quality.

In FY2009, there were 12 FTEs (9 research and 3 extension) associated with our *Ecosystems and Biodiversity* planned program. Outputs of this program included 25 awarded grants (of 48 submitted), mentorship of 43 M.S. and 6 Ph.D. graduate students, 23 refereed publications (scientific articles, books, and book chapters), 60 extension fact sheets, 59 invited and 115volunteered presentations, 7 websites, and 65 workshops. Examples of ongoing research and extension efforts include: studies of the biological control of invasive plants (e.g., "mile-a-minute" weed, kudzu) in agricultural and natural ecosystems; the ecological changes in natural ecosystems caused by widespread use of alien invasive plants in home landscapes; strategies to manage the increasing deer population which is damaging agronomic crops, homes, and natural areas; pollination biology for bees as it relates to the major problem of colony collapse disorder; effects of marsh management strategies (e.g., flood control) and atmospheric deposition of mercury on breeding ecology of coastal birds; studies on how to restore migratory pathways for migratory birds; estimating habitat carrying capacity for wintering and spring staging American black ducks in coastal areas; and continuation of the longest running ongoing study of the wood thrush, a neo-tropical migrant of conservation concern, that has generated, over the past 31 years, a data set of unparalleled value. In FY 2009, research continued and expanded on the taxonomy of delphacid planthoppers (Hemiptera: Fulgoroidea: Delphacidae), particularly of the New World. This included development of online keys, checklists, and information on North American delphacid planthoppers, including potentially invasive species. Specific accomplishments included revision of select delphacid genera and descriptions of new species, completing decriptions of two new genera of Stenocraninae, and progressing on the revision of the genera Tetrasteira Chionomus, and a species segregate of Delphacodes.Integrated pest management research and extension continue to focus on key pests of crops important to regional vegetable production, particularly pickling cucumbers and watermelons. In Delaware, and Maryland, pickling cucumbers are grown on approximately 8,000 acres. Each year losses from insect, disease and weed pests can result in reduced returns to producers. Two key pests identified by producers are downy mildew and cucumber beetles. The following high priority research and extension needs were identified as part of a pest management strategic plan for pickling cucumbers : development of a forecasting and predictive system for downy mildew, evaluation of currently available and pipeline fungicides for downy mildew control, development of resistant cultivars, and the evaluation of commercially applied seed treatments for cucumber beetle control. In FY 2009, research and extension programs for cucumbers continued to focus on four main areas: (i) Downy Mildew forecasting as part of a National ipmPipe system; (ii) evaluation of new chemistry to control downy mildew management; (iii) establishment of sentinel plots to detect the first occurrence of downy mildew in DE and (iv) the evaluation of seed treatments for cucumber beetle management. Newer seed applied treatments for cucumber beetle control on pickling cucumbers provided economic control, increased worker safety and resulted in a 2-fold reduction in the amount of active ingredients in the environment compared to at planting insecticides. With the 2009 federal registration of one commercially applied seed treatment, growers were able to save $20 per acre compared to at planting insecticides on 500 acres of pickling cucumbers. The Cucurbit Downy Mildew forecasting system in combination with the use of sentinel plots to study pathogen movement helped growers in the region minimize economic and environmental costs of fungicide sprays by helping them time application when and where they were needed. This information was posted throughout the season on our eekly Crop Update which reaches close to 300 clientele including pickling cucumber growers, consultants, agri-business and seed company representatives. The cool, wet weather conditions in 2009 were very favorable for downy mildew. The Downy Mildew PIPE in combination with sentinel plot detections and field scouting accurately predicted the occurrence of downy mildew in the region resulting in timely sprays on all pickling cucumbers in region preventing losses in all fields in the susceptible growth stage (approximately 4,000 acres). For watermelons, current programs also continue to incorporate sustainable strategies including disease scouting; the use of weather based disease forecasting system to time fungicide application and the use of new thresholds and reduced risk chemistry for mite management in watermelons. The use of a cantaloupe trap crop to reduce cucumber beetle sprays on watermelons was evaluated on three producer locations. Growers were able to reduce one to two sprays on their watermelon acres resulting in a savings of $ 10 per on 500 acres of watermelons. The current multi-state watermelon IPM program continues to demonstrate the value of using the Melcast Disease Forecasting System on over 2000 acres of watermelons. When using Melcast, growers and consultants continued to

report improved disease management resulting from better timing of fungicide applications. Also, in FY2009, Cooperative Extension educational outreach to producers continued to thrive and work across state boundaries. Consultants, Agribusiness, Agency Personnel, and Extension Agents have all expressed an interest in receiving cutting edge information on new Integrated Pest, Nutrient and Crop Management strategies. Since this group often has clientele in multiple states, they would like to receive information that has application on a regional basis. They would also like to learn more about finding crop and pest management information on the web. Surveys indicate that this group of clientele would like to receive this information at intensive, multi-day training sessions. The Mid-Atlantic Crop Management School is an excellent example of a multi-state (Delaware, Maryland and West Virginia) and multi-agency (University, NRCS and Department of Agriculture) program which provides new educational information in the areas of Integrated Pest Management, Crop Management, Nutrient Management, and Soil and Water Management. The 2009 Mid-Atlantic Crop Management School educated 210 individuals including private consultants, agribusiness personnel, NRCS field staff and extension agents about a wide range of new pest and crop management topics. Survey results indicated that this group consults on over 797,000 acres in the Mid-Atlantic region. As a direct result of a survey of school participants, this conference expanded topics directly related to safeguarding the environment by including topics on the indirect effect of Bt-corn on vegetable crops, managing cover crops to help control weed problems and management of arthropods through modification of crop environment. Topics were also included that addressed another goal of IPM which is maintaining the economic viability of agriculture. Examples of topics that addressed this goal included wheat rusts: current and future threats, weed management in pasture and hay crops and new development in seed treatments for corn and soybeans. Mid-Atlantic crop management school participants were surveyed and indicated that new IPM, nutrient management and crop management information presented would result in an increase of $ 25 per acre in income for their clientele. Finally, in FY2009, the University of Delaware Center for Managed Ecosystems, established in 2007, continued to expand its efforts to become a leading interdisciplinary center dedicated to improving the ability of urban, suburban, and agricultural landscapes to support the plants, animals, and physical conditions essential to the long-term productivity of the ecosystems on which humans depend. Collaborative partners in this Center include the U.S. Forest Service, the Delaware Department of Natural Resources and Environmental Control, the UD Botanic Gardens, the Baltimore Ecosystem Studies group, and the Delaware Invasive Species Council. The Center recently initiated a new study of acid rain impacts on soil calcium levels and the relationship of soil acidification on the ecological impacts of invasive plants in 35 woodlots including habitats on the University's newly purchased Chrysler property. Current work suggests that changes in soil pH due to acid rain, fertilizers, and other inputs initiates a cascade of effects on arthropods, amphibians, and birds. One of the clearest effects of acidification is a reduction of available calcium in soils, which in turn affects calcium-rich prey items that are important to breeding songbirds. Less is known about the interaction of soil pH and invasive plants, although 2009 results showed clear differences in soil pH under native vs. exotic invasive plants. In 2010, the effects of non-native plant invasion on nesting sites, songbird prey availability, and territory sizes will also be investigated using a long-term (~40 yrs) data set available at one of the sites.

Family and Youth Development:

The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems are not only confined to rural areas where development and urbanization of farmland are changing the nature of communities and the opportunities for youth, but also are found in our towns and cities. Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often do not have the time, money, or skills to carry out their family roles in a positive, productive manner. Preparing citizens to take prominent roles in shaping their future and the future of their communities is the fundamental goal of this planned program. Cooperative Extension activities are the major component of this program and focus on: helping youth develop the leadership and life skills needed to become productive, independent contributors to our society; increasing the educational opportunities in science, engineering, and technology for youth; providing guidance and training in areas important to financial security of families and to family well-being across the generations; and safe community programs on drug and alcohol prevention and safety training for vehicles, bicycles, pedestrians, farm families, and businesses.

In FY2009, there were 22 FTEs (21 extension, 1 research) associated with our Family and Youth Development planned program. Outputs of this program included 24 awarded grants (of 39 submitted), 77 extension fact sheets, 74 invited and 134 volunteered presentations, 10 websites, and 647 workshops. Ongoing extension efforts in this area include Great Beginnings - A series for parents of infants and young children, eXtension Just in Time Parenting, and Families Matter! - A series for parents of school-age youth. Just in Time Parenting &ndash starting prenatally and continuing through adolescence &ndash is available nationwide to every interested parent. JITP readers across all educational and economic levels report that: they feel more confident and competent in raising their children; JITP newsletters are more useful than any other source of information; they share and discuss the newsletters within their family and social networks. In studies in Delaware, those who report they change their behaviors and attitudes most &ndash as a result of reading the newsletters &ndash are youngest, poorest and least educated. Other major programs include a Financial Management Education Training Program conducted in cooperation with agencies such as the Delaware State Housing Authority, AIDS Delaware, Neighborhood House Community Center, credit unions, housing counseling agencies and the Delaware Division of Emergency Services; After-School outreach programs at nine sites throughout the state that serve some of our lowest income youth by providing

activities covering a wide range of topics in Science and Technology, Healthy Lifestyles and Nutrition, Community Service, Leadership, Arts and Crafts, Aerospace, Woodworking and Public Speaking. In addition all the programs offer nutritious snacks and/or hot dinners in collaboration with the Food Bank of Delaware; healthy lifestyles training, teen development workshops, and one of the largest and most successful 4-H programs in the US. More than 55,000, Delaware youth representing 45% market share of 4-H aged youth who reside in the state (more than twice any other state in the union), take part in 4-H clubs, after-school programs in a number of low resource communities, camps and other activities. 4-H helps Delaware youth develop the skills necessary to be marketable in tomorrow's workplace. Key activities in FY 2009 included statewide programs in Science, Engineering and Technology (SET) &ndash 4-H youth ages 8-19 are exposed to diverse areas of science, engineering and technology as they participate in hands-on activities in environmental education, biotechnology, computer science, DNA mapping, the use of GPS instruments and manipulation of GIS data, etc.. In 2009, 18 4-H staff members were trained in the use of a new Robotics curriculum and GPS/GIS software in order to start one new 4-H club focused on these topics in each county for next year. In New Castle County 4-H has used more than 1,200 Agilent Technology science kits which means over 4,500 youth were exposed to STEM activities. Daily and summer 4-H afterschool programs are now offered at 6 of the Delaware State Housing Authority's 7 sites in rural Kent and Sussex counties, making quality educational programs available to Delaware's poorest children 200-210 days/year.; Healthy Living &ndash programming in this area addresses obesity in terms of making healthy eating choices, the importance of exercise, and alcohol and tobacco prevention; Citizenship &ndash 4-H youth participate in many community service projects, helping them realize the role they play in making a difference in the lives of others. Delaware 4-H also offers a variety of programs to assist Delaware-based military members and their families; and Leadership Development &ndash youth are positioned in leadership roles in every facet of the Delaware 4-H program.

Food Science, Technology, Safety, and Nutrition:

Outbreaks of foodborne illness and human health problems associated with poor or inappropriate diets are areas of national concern and the focus of this planned program. Food safety research will address methods by which we can enhance the safety and wholesomeness of foods by improving our understanding of the means that food pathogens exist, enter, survive, and propagate in foods and actuate disease syndromes in individuals who consume contaminated products. Strategies and technologies to prevent foodborne illness, such as the use of high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage, will be evaluated through multi-disciplinary research. Cooperative Extension outreach programs will increase awareness by producers, processors, food handlers, and consumers of effective strategies for food product safety. Educating the public, particularly youth, minority, and low-income groups, about the relationship between chronic diseases (e.g., cancer, diabetes, heart disease), diet, nutrition, exercise, and how to make choices that reduce the negative effects of diets on health will be another major focus of Extension.

In FY2009, there were 18 FTEs (7 research and 11 extension) associated with our *Food Science, Technology, Safety, and Nutrition* planned program. Outputs of this program included 10 awarded grants (of 37 submitted), mentorship of 14 M.S. and 5 Ph.D. graduate students, 22 refereed publications (scientific articles, books, and book chapters), 62 extension fact sheets, 113 invited and 96 volunteered presentations, and 312 workshops. Food science research focuses on food safety and innovative food technology applications. Specific ongoing areas of research include the use of non-thermal processing and anti-microbial packaging to pasteurize foods, prolong shelf life, and inhibit pathogens; basic research on the ecology and genetics of food pathogens; and the environmental factors associated with the transmission of pathogenic viruses and bacteria in agriculture &ndash from "farm to fork"; and microbial contamination of drinking water where an innovative new technology (zero-valent iron) has been developed to purify polluted drinking and irrigation waters. Novel studies have also been conducted on the separation and identification of bioactive compounds from foods, spices or medicinal herbs using column chromatography techniques, HPLC/PDA, LC/MS, GC/MS, and NMR analysis. Assessments of bioactivities of nutraceuticals and functional foods using antimicrobial tests, cell cultures, and antioxidant assays are also underway as are investigations into the effects of processing methods on efficacy and safety of functional foods and minimally processed foods and the long-term impact of bioactive compounds on obesity and heart disease. Extension programs focus on nutrition and food safety. In Delaware, 64 percent of adults are either obese or overweight while 14 percent of Delaware students in grades 9-12 are overweight and another 15 percent are at risk of becoming overweight. Of particular concern are youth since habits they learn early in life often persist into adulthood and it is very difficult to decrease weight later in life. "Exploring My Pyramid" was delivered to over 900 low-income and 4-H day camp participants throughout the state. Emphasis was on making healthy choices from all of the food groups and including 60 minutes of physical activity each day. Delaware was the first of two states offering vouchers for fruits and vegetables as part of the WIC package. At the request of the Delaware WIC program, Delaware Cooperative Extension implemented an in-store demonstration project to emphasize fresh produce and to help WIC clientele get the most value for their vouchers. Handouts were developed including a featured fruit or vegetable of the month, how to compare prices to get the most value for the vouchers, and a cost comparison of various forms of fresh produce. From January through the end of September, 34 in-store demonstrations were conducted at 22 different grocery stores. A telephone survey of individuals stopping at the display revealed 93 percent rated the display as either a 4 or 5 on a scale of 1 (poor) to 5 (excellent). Seventy-nine percent of the individuals tried the recipe featuring a fruit or vegetable of the month with 93 percent taking the recipes home and 15 percent trying at least one. There is an increased need for educational programs that address complex issues associated with the role of diet in prevention of chronic diseases such as heart

disease and cancer, childhood obesity, and safe food preparation practices. To extend the reach of Extension staff, an intensive 30 hour course in nutrition and food safety was developed to provide volunteers with the tools to either assist staff or to deliver basic programs. Eight individuals participated in the classes in the fall of 2009. For the 30 hours of training, each participant agreed to give back 45 hours of volunteer time. In the first four months after completing training, seven Master Foods Educators volunteered 105 hours to Extension with an approximate value of $2,265. Examples of volunteer activities include assisting with Eat Smart for a Healthy Heart, judging a 4-H favorite foods competition, and staffing both food safety and nutrition displays for a public event. Extension programs on food safety are expanding rapidly. With growing global concerns over the safety of fresh produces, with recent outbreaks of salmonella in spinach, tomatoes, and peppers, Delaware's fruit and vegetable growers are seeking ways to reduce foodborne illness through good agricultural practices on the farm. UD food safety research and extension specialists have joined with agricultural extension specialists to offer food safety training for produce growers and have increased efforts to provide support to growers wanting to implement related practices. Produce growers in Delaware have begun to implement these practices on farm. Training throughout the state was conducted in 2009 and continues in 2010. In 2009, grower attendance represented approximately 50% of the acreage devoted to fruit and vegetable production. Food Safety for Entrepreneurs Training was also conducted for farm operators wishing to be licensed to produce value-added products during 2009. Training throughout the state was conducted in 2009 and continues in 2010. In 2009, grower attendance represented approximately 50% of the acreage devoted to fruit and vegetable production. Food Safety for Entrepreneurs Training was also conducted for farm operators wishing to be licensed to produce value-added products during 2009.

Plant Biology and Crop Production Systems:

Despite growing pressures to convert farmland to urban/suburban uses, production agriculture in Delaware remains a strong and vital part of the state's economy. Grain and vegetable crop production are cornerstones of Delaware agriculture and many opportunities exist to increase the productivity, profitability, and environmental compatibility of these systems and sustain them as viable land uses for the future. At the same time, interest is growing in new uses for existing crops (biodiesel fuels from soybeans, ethanol from corn), in alternative, high value plant production systems (greenhouses for producing genetically engineered pharmaceutical and nutriceutical plants, herbs, spices, essential oil plants, exotic specialty vegetables and other niche market, high value plants), and in the long-term impacts of global climate change on environmental conditions affecting plant growth and crop yields. Key areas of emphasis in this planned program continue to be: improving our understanding of plant genomes and the application of genomic information for crop improvement, crop quality, and crop protection; plant-soil interfacial reactions at the molecular scale to increase our knowledge of factors controlling symbiotic relationships between plants and soil microorganisms and plant uptake of nutrients and heavy metals; increasing the efficiency of crop management systems by better cultural techniques, innovations in nutrient and manure management, adoption of improved crop and vegetable varieties, and enhancing the marketing skills of all producers; developing cultural practices and marketing strategies for niche crops and mixed-use farms (beef and goats on pastures); and research and extension programming on plant management strategies for suburban ecosystems that are environmentally sound and protect water quality and wildlife habitats.

In FY2009, there were 41 FTEs (27 research and 14 extension) associated with our *Plant Biology and Crop Production Systems* planned program. Outputs of this program included 20 awarded grants (of 44 submitted), mentorship of 16 M.S. and 9 Ph.D. graduate students, 20 refereed publications (scientific articles, books, and book chapters), 33 extension fact sheets, 64 invited and 83 volunteered presentations, 8 websites, and 80 workshops. Some of the research programs in this area include projects focused on corn breeding for disease and drought resistance and to improve the availability of phytate-P in corn grain used for animal feeds, thus helping to reduce P concentrations in manures and protect water quality. Corn genetics research continues to focus on bridging plant molecular genetics with field corn breeding, developing and applying methods to study natural variation and understand the genetic basis of plant improvement. Studies in this area in FY 2009 focused on quantitative trait variation, generally controlled by multiple genes with small and cumulative effects, which is the rule rather than the exception in nature. These projects use population genetic-, genomic-, and bioinformatic-based approaches to address questions in plant genetics and breeding to help elucidate the genetic architecture of plant quantitative disease resistance in the grasses with a special focus on maize. Specific research areas included: (i) development of methods for understanding population improvement from short-term selection, (ii) analysis of single and multiple disease resistance, and (iii) extending quantitative genetics methods to study natural plant pathogen variation. Other novel studies are using plant tissue culture to develop propagation protocols for plants native to the eastern temperate U.S.; interactions between fungal pathogens of rice, barley and potatoes with emphasis on the transcriptional and translational regulation of genes that may play critical roles in the interactions between these destructive pathogens and their hosts. For example, recent plant molecular biology research has focused on rice blast, a fungal pathogen that kills enough rice each year to feed 60 million people. The research investigates the complex nature of the interactions between rice plants and fungal plant pathogens in an effort to develop resistant strains of rice and reduce fungicide use; plant molecular biology research on the biological significance of root exudation and the root-root, root-microbe, and root-nematode communications continues and has expanded to assess the effects of climate change on these processes. Past studies with the invasive strain of *Phragmites australis*, a plant causing major ecological problems in wetlands, showed these plants exude from their roots gallic acid, a toxin that can disintegrate the structural proteins in the roots of neighboring native plants, leading to major

losses in biodiversity due to the dominance of *Phragmites* in many wetlands. In FY 2009, the research team reported the effects of of UV-B radiation, of growing concern because of global warming, on plant allelopathy in wetlands. They determined that the gallic acid released by *Phragmites* can be degraded by ultraviolet light to produce another toxin, mesoxalic acid, which triggers a similar "cellular death cascade" in victim plants as gallic acid, destroying the tubulin and actin, the structural protein in the roots, within minutes of exposure. Cooperative Extension programs are addressing the interactions between invasive and native plants in natural and managed settings (e.g., Delaware highways); understanding and managing herbicide resistance in weeds impacting important agronomic crops; evaluating soybean varieties resistant to the emerging problem of Asian soybean rust; and developing management practices and plant breeding programs for lima beans, one of Delaware's most important vegetable crops. In addition, Extension programs have worked closely with NRCS and irrigation dealers across Delmarva to improve irrigation management strategies and water utilization in agronomic and vegetable crops. Also, Extension researchers have been working with new forms of slow release nitrogen fertilizers to improve nitrogen management in crop production. Finally Extension entomologists have worked this past year on IPM strategies for management of Dectes Stem Borers and Stink Bugs in soybeans

Rural Development and Land Use Change: While agriculture remains an important sector of Delaware's economy, continued growth of the banking, recreation, retirement, retail, and wholesale trade industries has led to a growing suburban population and pressures to convert farms to other uses. Land use change is now a major social and political issue. Developers and farmers are pursuing conversion of cropland into housing and related infrastructure, while the state is attempting to restrict land use conversion by preserving farmland and natural resource areas. Loss of farmland will have far-reaching impacts on Delaware agriculture for several reasons. Perhaps most important, the majority of Delaware's cropland is used to produce grain crops for the poultry industry. Loss of this grain supply will create economic pressures on poultry integrators who will have to import grain from other regions at greater costs. Many Delaware farmers also now regularly face challenges as they interact with neighbors who are unfamiliar with farming and complain about odors, dust, noise, machinery on roads, and possible environmental and human health problems of pesticides, fertilizers, and manures. Fragmenting the agricultural landscape into smaller farms interspersed amongst suburban developments is also changing the social fabric of Delaware's rural communities. These demographic changes affect family and community values, political decision-making, the education and skills needed for new types of careers, and the financial stability of individuals and families. Our research and extension efforts focus on: aiding statewide efforts to understand, manage, and revitalize land use change, including reducing conflicts as change occurs; defining the necessary "critical mass" for future agricultural viability and the relationships between urban and rural land uses important to sustaining agriculture in the long-term; working with rural families to respond to changing communities through programs focused on education, career skills, and financial planning; helping to develop land use policies that are protective of the environment; and preserving agriculturally productive land and natural resource areas for future generations.

In FY2009, there were 12 FTEs (8 research and 4 extension) in our *Rural Development and Land Use Change* planned program. Outputs of this program included 8 awarded grants (of 14 submitted), mentorship of 13 M.S. and 4 Ph.D. graduate students, 10 refereed publications (scientific articles, books, book chapters), 2 extension fact sheets, 7 invited and 10 volunteered presentations, 2 websites, and 34 workshops. Research in this planned program continues to focus on various policy aspects of farmland preservation such as willingness to pay for land preservation across states and jurisdictional scale and analyses of benefit transfer equivalence policies; research on use of theoretical modeling and optimization to reveal potential agricultural and ecological gains obtained by incorporating optimization into selection methods, including the use of game theory and mechanism design to develop strategies to overcome incentive problems; application of experimental economics techniques to better understand public-buyer private-seller auction markets, directly relevant to Delaware's conservation programs and having national implications for the USDA Conservation Reserve and Conservation Reserve Enhancement Programs and the Wetland Reserve Program; economic analyses of various policies affecting the willingness to pay for green energy; and research on international aspects of trade openness and economic growth and spatial price dynamics related to poultry and grain production. Extension programs address farm business management skills through programs of the Northeast Center for Risk Management Education (serving New England states, New York, New Jersey, Pennsylvania, Maryland, West Virginia, and Delaware). This center was established at the University of Delaware to educate producers of agricultural products about the range of risk management opportunities available to them in order to maintain profitable businesses; expanding e-Commerce opportunities for farm fresh markets and agri-tourism Industries; and providing targeted risk management and financial programming for women in agriculture, through regular support and an annual statewide conference. Several Extension programs actively addressed the land use and rural development problems in southern Delaware in FY 2009. Sussex County, the largest county in Delaware, 606,000 acres is experiencing rapid growth due to its proximity to the Atlantic Ocean, low property taxes and proximity to a large population centers in the Mid-Atlantic region. The majority of new landowners in Sussex are retirees. Sussex County is the largest broiler producing county in the country which supports the large acreage of grain production. Several conflicts emerge, the classic urban-rural lifestyle, the conversion of agricultural working lands to development and revising rural governments e.g. codes and services to meet the changing demands of the new residents. The community development extension agent has partnered with UD colleagues in from Sea-grant Marine Advisory Service and the Institute for Public Administration through the Coastal Community Enhancement Initiative (CCEI). Several land use educational efforts are underway. Heart & Soul of

Sussex County is a program designed, in Phase I, which was completed in FY 2009, to engage residents in identifying the core elements (what we value) of Sussex County. The second phase of the project intended to engage residents in thinking through the implications of how to use those elements e.g. economic development, revision of land use codes etc. is underway and will be ongoing for several years. The CCEI Sussex County land use study is currently using Community Viz (a land-use decision making model) to develop sub-regional plans. This second phase has surfaced for public discussion the inherent trade-offs necessary to support a viable agriculture industry and meet the needs of new residents. The CCEI team works in partnership with local jurisdictions and the Office of State Planning Coordination to engage stakeholders in plan development. The community development Extension agent and the CCEI partnership are heavily involved in rural economic development through the Sussex County Economic Development Action Committee. They are working together to develop and are implement a work plan that includes the creation of a business resource center and other strategies based on economic gardening principles. A leadership development program for business and community leaders will be launched in 2010. In other activities, LEADelaware, a leadership program for agriculture and natural resource professionals continues to provide an environment for experiential learning and the development of lasting relationships among participants.

Soils and Environmental Quality:

Delaware's soil resources underpin agricultural success and are also linked closely with many of the long-term environmental challenges facing the state today. The major soils-related challenges we face are related to land use change, production agriculture (particularly large-scale poultry operations), and industrial pollution. We are losing the most productive agricultural soils in the northern part of the state to suburban development at an alarmingly rapid pace. The environmental impacts of increased impervious surface and nutrient and pesticide use by new landowners are not well understood and will require more educational programs by Cooperative Extension in the future. Southern Delaware, the heart of production agriculture and the poultry industry, is characterized by sandy soils which are prone to drought and leaching, and have shallow ground waters that are hydrologically linked to rivers and important coastal estuaries. Nonpoint nutrient (nitrate, phosphate) pollution of groundwater aquifers, which impacts drinking water supplies and aquatic ecosystems, such as our Inland Bays (a national estuary), has been a serious problem for more than 35 years. Recent advances in nutrient management, including the passage of a state nutrient management law, have begun to significantly improve N and P management statewide. However, it is likely that phosphorus which has accumulated in soils, and nitrates which have accumulated in shallow aquifers, will continue to contribute to water quality degradation for many years. There continues to be a need for innovative research and extension programs that can improve nutrient management practices by production agriculture. Other soil problems where we plan research are the remediation of metal and organic chemical contaminated soils in urban brownfields, emissions of gases and particulates from soils and surface applied waste materials (e.g., manures, biosolids) that can affect air quality, climate change, human health and nearby ecosystems; and the fate, transport, and potential human health impacts of pathogens (viruses, bacteria) originating in manures and other by-products.

In FY2009, there were 24 FTEs (18 research and 6 extension) in the Soils and Environmental Quality planned program. Outputs of this program included 22 awarded grants (of 40 submitted), mentorship of 14 M.S. and 15 Ph.D. graduate students, 35 refereed publications (scientific articles, books, and book chapters), 7 extension fact sheets, 20 invited and 59 volunteered presentations, 7 websites, and 76 workshops. Major research areas included basic soil chemistry research on fate, mobility, and transformation of toxic metals such as arsenic, nickel, and zinc and plant nutrients such as phosphorus and sulfur. Much of this research is conducted at the molecular or atomic scale at synchrotron facilities located at National Research Laboratories; interdisciplinary research on processes regulating nutrient and metal uptake by plants, important for agronomic crops and remediation of metal contaminated soils using hyperaccumlator plants; nutrient cycling and transport in soils amended with manures and municipal biosolids with particular emphasis on managing high phosphorus soils to protect water quality; innovative strategies to enhance the effectiveness of vegetated filter strips (buffers) at mitigating nitrogen and phosphorus pollution of ground and surface waters; fundamental studies of the processes controlling the movement of viruses through soils to ground waters &ndash and practices that can be used to prevent ground water contamination; ecology and diversity of microbial populations in soil-plant systems and microbial community responses to environmental perturbations; effects of soil-borne viruses on microbial communities; soil hydrology and microbial ecology as related to the morphology of hydric soils and functional assessment of wetlands; watershed hydrochemistry research focused on how topographic, hydrologic, and soils conditions in watersheds control the transport and fate of solutes and chemicals and how riparian and wetland ecosystems impact hydrologic and biogeochemical processes in watersheds; and process-based modeling of geochemical soil formation across diverse landforms. Extension programs in this area focused on nutrient management and are nationally recognized for statewide education and certification of all nutrient users and for on-farm demonstrations of the latest best management practices for efficient nutrient use. In FY2009, Cooperative extension continued their efforts in nutrient management, offering 21 nutrient management certification classes and a total of 72 credit hours in continuing education attended by more than 1,800 individuals. Nutrient management certification has evolved to include both agricultural and non-agricultural audiences; particularly turfgrass managers such as golf courses and lawn care companies. Nutrient management research activities included a regional project focused on adaptive management using the cornstalk nitrate plant diagnostic test as a means to adjust and improve nitrogen management on more than 300 farmers' fields. Other extension efforts include increasing the use and efficiency of irrigation and evaluations of the use of soil testing, plant tissue testing, improved strategies for poultry litter stockpiling (including on-farm studies of the impact of stockpiled litter

on soil and water quality) and remote sensing to improve nutrient efficiencies in corn. One major success story related to nutrients and water quality in FY 2009 was formation of a statewide extension and research team in response to growing interest in expanding irrigated crop production and increasing the efficiency of existing irrigation systems. The Delaware PIER team (Panel on Irrigation Extension and Research) was established in 2009 and has been strongly supported by state and federal agencies interested in enhancing the profitability of Delaware agriculture. The 30-member PIER team has a broad range of expertise encompassing all aspects of irrigated crop production, including research, extension, conservation planning, irrigation engineering, environmental observing systems, and water policy and technical support. The PIER team is now developing and beginning to implement improved watershed-scale irrigation and nutrient management strategies for Delaware agriculture. Expanding irrigation use and increasing the efficiency of existing irrigation systems, in conjunction with the already widespread use of agricultural nutrient management plans, will reduce nutrient loading by enhancing crop uptake of nitrogen (N) and phosphorus (P), increasing crop yields, and improving nutrient use efficiency by irrigated crops. Assessing and promoting the appropriate adoption of new, and potentially more efficient, irrigation technologies such as an internet-based irrigation scheduling network, wider use of new soil moisture sensors, and subsurface drip irrigation (SDI), is another component of this project.

The Science and Practice of Aquaculture:

The development of an aquaculture industry in Delaware has the potential to enhance diversification of farming in this region and increase farm income. Currently, the major obstacles to growth of the aquaculture industry are high (and growing) land costs and the lack of significant examples of aquacultural success in Delaware. Extension programming and research will focus on identification of the best aquaculture crops and management techniques that can minimize disruption of current farming practices and maximize available resources. Other areas of effort will include educating farmers, community leaders and other interested individuals on biological, technological and social issues pertaining to aquaculture.

In FY2009, there were 2.6 research FTEs and 0.4 extension FTEs associated with Planned Program #9. Outputs of this program included 4 awarded grants (of 8 submitted), mentorship of 5 M.S. graduate students, 7 refereed publications (scientific articles, books, and book chapters), 7 extension fact sheets, 5 invited and 10 volunteered presentations, 1 website, and 6 workshops, 1725 newsletters distributed, and 10 new program partners. Examples of continuing research projects include interactions between algae, shellfish, and water quality with an emphasis on how nutrient pollution impacts shellfish ecology; and conservation of endangered species using aquaculture techniques. Extension programs are closely aligned with ongoing research and address management practices for both freshwater and marine aquaculture; water quality impacts of aquaculture production systems, particularly aquaculture effluents; integrated aquaculture/agriculture systems; and new recirculation technologies.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	53.9	11.0	109.9	18.0
Actual	54.4	10.0	106.9	14.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review
- Other (Northeast Cooperative Extension Directors)

2. Brief Explanation

Scientific Peer Review of Research Programs is conducted in accordance with the National Standards for Peer Review

Merit review for Delaware Cooperative Extension consisted of five levels of peer and stakeholder review. Extension professionals submit county plans each year that have been reviewed by their peers within the

county and by county stakeholder advisory groups. These stakeholder groups then provide input on critical needs and issues within their communities, which is used to develop the county plans. After county plans are complete, stakeholders review them for inclusion of the previously identified needs and issues, as well as, program delivery and evaluation methodologies. Each of these plans includes specific objectives that are examined for relevance, usefulness, and potential impact of the programs. This feedback is used to refine county plans and develop future plans. The second level of review is by college-wide issue teams that are cross-functional and multi-disciplinary. From this review, county plans are combined into a college-wide plan. The third level of review is both within and outside the university community. Copies of the plan are submitted to university administrators and related agency personnel who function as both present and future partners. These individuals are invited to comment on the objectives identified, areas of collaboration, and potential impacts. University administrators are also asked to comment on ways in which we might work across colleges and schools to increase our outreach efforts. A fourth level is with statewide stakeholder groups, including advisory groups, commodity organizations, volunteers, research partners, and state and local funding agencies. These groups are asked to provide feedback regarding objectives, potential impacts, and how it meets their specific needs. The final level is the Northeast Extension directors, who have agreed to share all state plans among each other. This peer review helps states advise each other on opportunities to strengthen individual state plans and ways that we can collaborate across state lines.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey specifically with non-traditional groups
- Survey of selected individuals from the general public
- Other (Permanent advisory committees for extension programs and researc)

Brief explanation.

In the State of Delaware, the University of Delaware and Delaware State University use a multi-faceted approach to secure stakeholder input. We believe in direct contact with people and actively solicit input from a wide variety of clientele, users and stakeholders. College administrators, faculty working on research funded by state and federal agencies or industry, and Cooperative Extension staff regularly request input on the relevance of our research and extension priorities to state and regional problems. Numerous formal opportunities for input also exist and include, but are not limited to, the following: extension overall advisory committees, extension issue-based advisory committees, strengthening families statewide advisory committee, 4-H volunteers, 4-H Foundation, LINKS, agriculture commodity groups, environmental interests, the green industry, agribusinesses, agriculture associations (i.e., Farm Bureau, Grange, Pork Producers Association, Delmarva Poultry Industry, Soybean Board, Sheep Producers Association, etc.), Master Gardeners, Master Food Educators, and Master Financial Planners. We meet with these groups on a regular basis and request their input on our programs and encourage their involvement in all of our planning efforts.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

Stakeholders are identified by a combined effort of college administrators, research and teaching faculty, and Cooperative Extension staff. We are very familiar with our traditional agricultural stakeholders and have established a number of advisory committees, at the county and state levels, to provide input on our research and extension programs. Similarly, we have long-standing contacts and good relations with many individuals, organizations, and agencies involved in the natural resource and environmental matters important to our research and extension programs. We work hard to ensure that these committees represent the range of agricultural production systems present in the state, the interests of those concerned about natural resources and the environment, and the social and economic issues related to communities, families, and youth development. We also take proactive steps to ensure that our advisory committees encompass the increasing diversity (age, gender, background, ethnic group) of our stakeholders. When new issues come forth, or a need for re-organization and re-direction of an existing program arises, we often establish focus groups composed of a mix of individuals internal and external to our universities to help guide our planning and to ensure that all interested parties are contacted for input. As appropriate, we also use surveys and open listening sessions to solicit input from the public.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Meeting with invited selected individuals from the general public
- Other (Meetings with permanent advisory committees)

Brief explanation.

We hold a variety of regular meetings across the state, which include a diverse mix of clientele, users, and stakeholders. These meetings include such things as: Agriculture Visiting Committee, State Chamber of Commerce, Kids County Advisory Council, Delaware Public Policy Institute Task Force, Friends of Agriculture Breakfast series, Council of Farm Organizations, USDA Food and Agricultural Council, State Agriculture Technical Committee, and user groups like 4-H regular and day camp parents. Students enrolled in our colleges, faculty, professionals, and salaried staff, are all encouraged to provide input on program priorities. We have conducted random surveys of users and non-users of the programs and activities on a variety of issues including land use and economic development. Other tools that we use to get input include visioning processes and focus groups. Periodically, the Delaware Secretary of Agriculture asks the University of Delaware and Delaware State University to participate in the development of a county-level, statewide, or regional plans for agricultural research and extension programming, often in targeted areas of importance. All of these efforts have been focused on both building commitment and getting input from stakeholders such as government agencies, industry partners, and regulatory agencies. Our programs have expanded and input continues to increase. We are recognized as a source of not only useful but also reliable information. We will continue to seek input in a variety of ways. These methods will change as the issues themselves change.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- To Set Priorities

Brief explanation.

{NO DATA ENTERED}

Brief Explanation of what you learned from your Stakeholders

1) Energy - as it dramatically affects both the costs of producing agricultural crops and the future of nature and management of cropping systems, the impact of energy, and the economic volatility associated with energy supply, on agriculture is of highest priority today. How will farmers adapt to the competing demands from food and energy markets for their products in a manner that sustains profitability and protects the environment?

2) Land use change - as the economic pressure to convert farmland to suburban and urban uses grows ever-greater, how will we sustain our agricultural land base to produce food, energy, fiber, and other products? How will the ecological and environmental benefits associated with agriculture be provided if crop land is converted to development? Recent major budget cuts to Delaware's nationally recognized farmland preservation program are an immediate concern with serious long-term implications for agriculture.

3) Water and air quality &ndash despite intensive efforts to develop agricultural management practices that protect water quality, nonpoint pollution of ground and surface waters remains a serious problem. Development is competing with agriculture for ground and surface water raising concerns about water supply in the future. Air quality concerns are growing, particularly for animal agriculture. Global climate change offers new opportunities for farmers and foresters as interest in biological approaches to sequester carbon grow rapidly. Will an integrated approach to water and air quality problems facing agriculture today emerge to support research and guide policies to enhance agriculture in the future?

4) Farm labor &ndash demands and opportunities in other sectors increasingly make it difficult for farmers and other sectors of the agricultural community to hire and retain qualified labor. Many farmers are also concerned about the future of agriculture due to the major economic hurdles faced by young men and women who wish to pursue agriculture as a career. These challenges are directly linked to the need for policies that can preserve farmland, resolve complex immigration issues, and more rapidly advance the mechanization of agriculture. How will national policies affect our ability to sustain a viable population of farmers, maintain a stable farm labor base, and increase investments in the innovative technologies needed to increase agricultural productivity in the face of all these challenges?

5) Irrigation &ndash major droughts in 2 of the past 5 years have emphasized the need for a statewide, long-term strategy to increase the amount of irrigated acreage. This will both increase agricultural profitability and help protect water quality by increasing nutrient utilization efficiency by irrigated crops, particularly with respect to corn and nitrogen management. Extension education programs on the latest advances in irrigation technology and research on nutrient management for irrigated grain and vegetable crops are priority areas for the next decade.

6) 4-H Youth Development &ndash Delaware 4-H continues to address high areas of need of youth, their families and communities in which they live. Examples of these programs include: a) Operation Military Kids Program that serves youth and their families from all branches of the military both active and reserve. A total of 2063 persons participated in "Ready, Set, Go Training," 360 individuals were reached by our "Speak Out For Military Kids" program and 2207 Hero Packs were distributed to military youth; b) daily afterschool and summer programs at five Delaware State Housing Authority complexes reaches 120 youth per day with quality afterschool programming designed to improve grades and reading skills. A sixth site will open this summer; c) Science, Technology, Engineering and Mathematics (STEM) programming continued as a major thrust.

7) Master Food Educators &ndash Americans face many challenges related to food safety and nutrition. Complex issues associated with the role of diet in the prevention of chronic diseases such as heart disease and cancer, childhood obesity, and safe food preparation practices often require knowledge and skills that consumers lack. In an effort to expand the delivery of high-quality, cutting edge programs in this area, Extension's family and consumer science (FCS) educators launched the Master Food Educators program. This program involves an intensive 30 hour course in nutrition and food safety designed to provide volunteers with the tools for assisting staff in the delivery of basic programs

8) Food safety &ndash Demand for more food safety education in the form of Servsafe for professional food preparers, Dinesafe for volunteer and casual food preparers, safe canning workshops and Good Handling Practices on the farm provide the impetus for extensive programming throughout the state.

9) Nutrition &ndash Because of the downturn in the economy the Expanded Food and Nutrition Education Program continues to grow, providing nutrition education to those individuals from low resource communities statewide. Childhood obesity and high incidences of chronic illnesses in Delaware, such as heart disease and diabetes, drive the demand for programming in this area.

10) Financial Management &ndash A steady demand for basic money management courses for those filing bankruptcy is driven through referrals from local attorneys aware that UD Cooperative Extension provides competent education for their clients.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1236699	1127073	1414430	1151031

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1065673	0	1414430	0
Actual Matching	1784933	106648	2017279	0
Actual All Other	4075481	0	8704130	0
Total Actual Expended	6926087	106648	12135839	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from				
Carryover	0	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

ANIMAL BIOLOGY, HEALTH, AND PRODUCTION SYSTEMS

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	5%	5%	5%	5%
302	Nutrient Utilization in Animals	15%	15%	10%	10%
304	Animal Genome	10%	10%	25%	25%
305	Animal Physiological Processes	10%	10%	20%	20%
307	Animal Management Systems	20%	20%	5%	5%
311	Animal Diseases	30%	30%	25%	25%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	5%	5%	5%
402	Engineering Systems and Equipment	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	3.2	2.0	30.1	2.0
Actual	2.9	0.4	26.9	1.5

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
70223	0	687109	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
59786	0	876641	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
345136	0	834854	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Poultry Health and Disease Prevention and Control - understanding mechanisms of disease induction, host genetic resistance and immune responses in broiler chickens emphasizing respiratory

diseases and oncogenic and immunosuppressive diseases. Disease prevention and control will focus on diagnostic surveillance methodology, vaccination and biocontainment procedures; (2) Poultry Growth and Development - understanding basic molecular and cellular mechanisms regulating poultry growth, development and meat yield; (3) Avian Genomics - development and application of avian microarrays for: disease diagnosis, resistance, and control; growth and development; and optimization of desired production traits; (4) Alternative Production Systems - evaluation of alternative production systems that reduce disease, mortality, and waste production, minimize antibiotic use, integrate solar power into poultry production systems and become more energy efficient, and foster compatibility between animal production, environmental quality, and the expanding urban population; (5) Nutrient Utilization in Poultry and Ruminants - increased nutrient utilization from an improved understanding of animal biology via the use of chemical and biological inputs and via improved management techniques to improve milk production, weight gain and feed efficiency; and (6) Equine Health and Management Systems &ndash outreach on equine health and management systems needed for growth of the industry.

2. Brief description of the target audience

Poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers and allied industries; livestock commodity groups; forage producers, equine owners, producers and interest groups; state and federal agencies; federal research laboratories; peer scientists, and environmental and community groups.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	15000	15000	10000	2000
Actual	42119	5895	8444	1000

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 1
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	3	22	
Actual	3	25	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	32	29

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	10	17

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	2	68

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	25	68

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	16	10

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2009	4	4

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	4	1

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	25	28

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	7	3

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	3	5

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	5	17

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	35	32

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	55	87

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	2

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	6	51

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness of the need to produce and utilize diets for all animal species that prevent unnecessary overfeeding of nutrients, especially nitrogen and phosphorus.
2	Education programs for the livestock and equine industries on equine nutrition and health practices, fiscal management, and beneficial use of the by-products of animal agriculture.
3	Establishment of an Avian Biosciences Center to conduct research, outreach, and K-12 educational programs on avian disease and production, food safety and technology, and the environmental compatibility of poultry production.
4	Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases.
5	Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.
6	Improved economic competitiveness of the poultry and allied industries relative to other poultry producing regions in the U.S. and global competitors.
7	Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization, and feeding diets with lower concentrations of nitrogen and phosphorus.
8	Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.
9	Increased number of diagnostic laboratories capable of using advances in avian genomics and state-of-the art instrumentation to rapidly diagnose infectious diseases
10	Disease Prevention and Control: basic and applied research on mechanisms of poultry disease processes will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.
11	Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.
12	Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, results of poultry directed research aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Nutritional effects on dairy cattle health and immune function including factors impacting white blood cell gene expression will be studied. Research will also lead to improved understanding of the molecular and cellular mechanisms associated with bovine lameness and early detection of the disease. Research will enhance collaboration between University and industry partners, will help increase the efficiency of livestock production and transfer new technology to stakeholders.
13	Environmental Compatibility: poultry industry and commercial nutritionists will adopt and implement recommendations for broiler diet modification - including such practices as reducing diet nutrient concentrations to more closely meet the animal's requirements, utilization of phytase and other diet additives shown to improve nutrient utilization, and incorporation of low phytate grains - in feed formulations to reduce nutrient emissions to the environment. Reduced emissions will be measured by reduced nutrient concentrations in manures and litters, reduced application of nutrients to cropland and other soils, and reduced movement of nutrients from soils to ground and surface waters. Other environmental issues related to animal agriculture include the fate and transport of trace elements

(arsenic, copper, zinc) found in poultry manures; widespread national concerns about air quality associated with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; the fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and the environmental and human health effects of antibiotics used in poultry production.

14	Equine science: contribute to improved equine care, disease prevention, responsible land management, barn safety, and effective business practices using proven outreach channels for the dissemination of peer reviewed knowledge and practices to equine professionals and enthusiasts.
15	Improved statewide strategies to prevent the spread of avian diseases and dispose of the mortality resulting from disease outbreaks.
16	Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.

Outcome #1

1. Outcome Measures

Increased awareness of the need to produce and utilize diets for all animal species that prevent unnecessary overfeeding of nutrients, especially nitrogen and phosphorus.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals

305	Animal Physiological Processes
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Education programs for the livestock and equine industries on equine nutrition and health practices, fiscal management, and beneficial use of the by-products of animal agriculture.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Lameness in cattle is one of the top two causes of herd loss and reduced productivity.

What has been done
New technology has been developed to detect lameness in cattle.

Results
Developed by UD faculty, the 1-dimensional force plate system designed for automated, objective lameness detection in cattle continues to be the leading technology in this field. The instrument has been commercialized by BouMatic LTD, Madison, Wiconsin and has become the center piece for their foot care program. BouMatic reports sales in Europe are good whereas sales in the US are sluggish due to sensitivity issues with the detection system. Currently the machine continues to contribute to a better understanding of the biomechanics of bovine lameness. As a result, we anticipate funding to generate a multi-dimensional machine the measures forces on the bovine limbs in 3 rather than 1 dimension.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
307	Animal Management Systems
311	Animal Diseases

401 Structures, Facilities, and General Purpose Farm Supplies

Outcome #3

1. Outcome Measures

Establishment of an Avian Biosciences Center to conduct research, outreach, and K-12 educational programs on avian disease and production, food safety and technology, and the environmental compatibility of poultry production.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases

Outcome #4

1. Outcome Measures

Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases

Outcome #5

1. Outcome Measures

Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual

2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
307	Animal Management Systems
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

Outcome #6

1. Outcome Measures

Improved economic competitiveness of the poultry and allied industries relative to other poultry producing regions in the U.S. and global competitors.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

Outcome #7

1. Outcome Measures

Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization, and feeding diets with lower concentrations of nitrogen and phosphorus.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems

Outcome #8

1. Outcome Measures

Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

Outcome #9

1. Outcome Measures

Increased number of diagnostic laboratories capable of using advances in avian genomics and state-of-the art instrumentation to rapidly diagnose infectious diseases

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
311	Animal Diseases

Outcome #10

1. Outcome Measures

Disease Prevention and Control: basic and applied research on mechanisms of poultry disease processes will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
307	Animal Management Systems
311	Animal Diseases

Outcome #11

1. Outcome Measures

Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
305	Animal Physiological Processes
311	Animal Diseases

Outcome #12

1. Outcome Measures

Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, results of poultry directed research aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Nutritional effects on dairy cattle health and immune function including factors impacting white blood cell gene expression will be studied. Research will also lead to improved understanding of the molecular and cellular mechanisms associated with bovine lameness and early detection of the disease. Research will enhance collaboration between University and industry partners, will help increase the efficiency of livestock production and transfer new technology to stakeholders.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems

Outcome #13

1. Outcome Measures

Environmental Compatibility: poultry industry and commercial nutritionists will adopt and implement recommendations for broiler diet modification - including such practices as reducing diet nutrient concentrations to more closely meet the animal's requirements, utilization of phytase and other diet additives shown to improve nutrient utilization, and incorporation of low phytate grains - in feed formulations to reduce nutrient emissions to the environment. Reduced emissions will be measured by reduced nutrient concentrations in manures and litters, reduced application of nutrients to cropland and other soils, and reduced movement of nutrients from soils to ground and surface waters. Other environmental issues related to animal agriculture include the fate and transport of trace elements (arsenic, copper, zinc) found in poultry manures; widespread national concerns about air quality associated with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; the fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and the environmental and human health effects of antibiotics used in poultry production.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

Outcome #14

1. Outcome Measures

Equine science: contribute to improved equine care, disease prevention, responsible land management, barn safety, and effective business practices using proven outreach channels for the dissemination of peer reviewed knowledge and practices to equine professionals and enthusiasts.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Equine owners and the industry that suports them

What has been done
Educational workshops and pasture walks

Results
Two equine pasture walk programs were offered during this reporting period. Participants learned about Natural Resource Conservation Services cost share programs and EQIP eligibility; on-farm manure storage facilities and storm water management projects; pasture management and managing the diet to avoid injuries and illness; rotational grazing and management practices; pasture nutrient needs and the rising cost of fertilizers and amendments. Program evaluations collected from participants were extremely favorable. Responses indicated that the information presented was excellent. Quality of the presentations, workshop format/style, and opportunity for discussion all received high marks from participants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes

307	Animal Management Systems
311	Animal Diseases
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

Outcome #15

1. Outcome Measures

Improved statewide strategies to prevent the spread of avian diseases and dispose of the mortality resulting from disease outbreaks.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The poultry industry, internationally, state and federal governments and agencies responsible for animal and human health.

What has been done
Training session on emergency responses to poultry disease outbreaks.

Results
UD faculty and staff conducted an "Emergency Poultry Disease Response Certificate program" Aug. 31-Sept. 3, 2009. The project team developed and offered a four day certificate course on Emergency Poultry Disease Response for ten poultry industry, allied industry, state personnel and veterinarians, and international guests. Participants included representation from Delaware, Maryland, Pennsylvania, Arkansas, North Carolina, and Marianas Islands. Topics in the course included understanding the biology of influenza virus, surveillance, biosecurity, outbreak response and control, incident command structures, protecting the responder and personal protection, depopulation, disposal and composting, and decontamination. Hands on demonstrations included personal protective equipment and swabbing, foam depopulation, protecting the responder, composting, and equipment disinfection. Pre-course and post-course assessment was very positive for the course. As one participant indicated, "every company in our industry needs this information." Participants in the course received 3.2 continuing education credits (CEU) and the institution became RACE certified for future veterinary and/or veterinary technician continuing education programs. The program currently has a funded commitment for 10 students in Year 2 with additional interest, which shows significant progress towards the goal of becoming a self-supporting sustainable educational program beyond the funding period of AICAP 2.

4. Associated Knowledge Areas

KA Code	Knowledge Area

307	Animal Management Systems
311	Animal Diseases
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

Outcome #16

1. Outcome Measures

Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
402	Engineering Systems and Equipment

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

BIOTECHNOLOGY AND BIOTECHNOLOGY-BASED AGRIBUSINESS

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	35%	35%	35%	35%
304	Animal Genome	35%	35%	35%	35%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
602	Business Management, Finance, and Taxation	5%	5%	5%	5%
603	Market Economics	5%	5%	5%	5%
604	Marketing and Distribution Practices	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	20.9	0.0
Actual	0.0	0.2	20.8	1.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	12163	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	721355	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3995154	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms of disease etiology and control and emergence of new disease causing agents. Research will continue and expand on sequencing of the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpesviruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutriceuticals, and plant with bioenergy uses.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office, Departments of Agriculture, Health and Human Services, Natural Resources and Environmental Control, Transportation), federal agencies (USDA, USEPA), land use organizations, environmental organizations, business and community leaders, families, students, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	150	400	150	750
Actual	164	300	200	800

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 1
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	12	
Actual	0	38	38

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	12	40

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	4	12

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	2	5

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	4	47

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	1	18

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2009	4	16

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	4	14

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	12	38

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	3	9

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	1	4

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	1	0

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	12	18

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	8	22

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	1	14

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	1	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome #1

1. Outcome Measures

Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
603	Market Economics
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
602	Business Management, Finance, and Taxation
603	Market Economics
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
601	Economics of Agricultural Production and Farm Management
603	Market Economics

Outcome #5

1. Outcome Measures

Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area

201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
National agencies supporting fundamental research in the molecular biology of avian disease; the pharmaceutical industry who invest in vaccine development; farmers engaged in poultry production.

What has been done
Basic resarch using molecular and genomic methods is being conducted to improve understanding of avian viruses and develop control strategies.

Results
Faculty labs in the avian biosciences area have developed models for the mechanisms by which an important poultry virus is evolving in virulence. Basic molecular studies on the functional effect of mutations in specific genes of Marek's disease virus have yielded important insight into the virulence evolution of this virus. The impact of this work is that it provides important knowledge for not only the poultry industry, but also the biomedical community. As virus-based anti-cancer vaccines become more widely used in humans (e.g., Hepatitis B, HPV, etc.), it is likely that these viruses will evolve the means to overcome the protection conferred by vaccines. The means by which these viruses do this, are likely to be similar to those observed in our system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

Outcome #8

1. Outcome Measures

Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and

climatic stresses, and remediate or stabilize polluted soils.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
National research agencies, industries, not-for-profit organizations, farmers and the public who are concerned about a safe and secure food supply.

What has been done
Basic molecular and genomic research on plant physiological processes that affect growth, yield, and insect or disease resistance.

Results
Faculty in the area of plant molecular biology have made strides in the exploration of pathogens affecting rice and other plants important to world food production and potential alternative energy solutions.
In recent research, faculty showed that when the leaves of the small flowering plant Arabidopsis thaliana were infected by a pathogen, the plant secreted an acid to recruit beneficial bacteria in the soil (Bacillus subtilis) to come to its defense. That work has spawned a new proposal to set up a hydroponic method for growing rice in laboratories at the Delaware Biotechnology Institute and the CANR. UD will partner with the University of California-Davis. UC Davis will grow rice in the field and supplying plant and soil samples to UD's lab for microbial and genetic analysis. A controlled experimental system will be established to dissect the impact of microbial associations on rice. Transcriptomic and metabolic profiling will reveal the genes actively being expressed by the plants in response to a variety of conditions. The profiles will be analyzed for global changes in gene expression, as well as specific functional classes of genes that would reflect changes in nutrient availability, or establishment of plant immunity, for example, which can be confirmed by metabolic analysis and susceptibility to pathogens.

In addition, UD faculty are researching solutions to a devastating fungal disease of rice known as rice blast. This work focuses on the complex nature of the interactions between the plants and fungal plant pathogens in trying to understand how certain fungi take advantage of a plant's "inner workings" to grow and reproduce. Currently rice growers rely on fungicides and host resistant strains to stop the fungus. However, the rice blast disease evolves quickly and can overcome these host resistances, as well as the fungicides. UD researchers are actively working to find a way to stop this devastating disease of the world's most important food crop.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #9

1. Outcome Measures

Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
602	Business Management, Finance, and Taxation
603	Market Economics
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

ECOSYSTEMS AND BIODIVERSITY

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	10%	10%	10%	10%
123	Management and Sustainability of Forest Resources	10%	10%	10%	10%
135	Aquatic and Terrestrial Wildlife	20%	20%	20%	20%
136	Conservation of Biological Diversity	15%	15%	15%	15%
215	Biological Control of Pests Affecting Plants	15%	15%	15%	15%
216	Integrated Pest Management Systems	20%	20%	20%	20%
306	Environmental Stress in Animals	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	3.8	1.0	6.1	2.0
Actual	3.6	0.5	5.9	2.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
330224	0	35496	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
241836	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
118390	0	1115622	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Integrated Pest Management - developing and delivering integrated pest management (IPM) programs, a "systems" approach using chemical, cultural, mechanical, and biological control to increase profits to producers and protect the environment; (2) Sustainable Agriculture/Forestry - developing and promoting efficient and sustainable agricultural, forestry, and other resource conservation practices and policies that ensure sustained ecosystem function and provide food and habitat for biodiversity, including crop diversification, agroforestry, native windbreaks, cover crops, living mulches, field border systems, and conservation buffers; (3) Wildlife, Woodlands, and Aquatic Resources - understanding and mitigating the impact of agricultural practices and urbanization on biodiversity, woodlands, and aquatic resources. Focus will be on human impacts on the fundamental processes that create and maintain biodiversity, such as atmospheric nitrification of ecosystems, minimal habitat requirements, speciation, predator-prey interactions, community and ecosystem structure, and extinction processes. Approaches to develop and sustain biodiversity in agriculture, suburban landscapes, and natural habitats, will be studied. Nonpoint source nutrient pollution models will assess impacts of land use/cover change from agriculture to urban on water quality and quantity on local ponds and creeks; (4) Wetlands Ecosystems - improve understanding of wetlands restoration, protection, and preservation. Emphasis will be on seasonally saturated and non-seasonally saturated wetlands, the wildlife species that inhabit them, and the importance of sedges in wetland habitats; (5) Protection of Delaware's Native Species - research on non-indigenous invasive species, a leading cause of plant and animal extinction in Delaware, will focus on impacts of invasive species on ecosystem function and on methods of restoration after their removal; (6) Master Gardener Training - Extension programs will be developed and delivered on Wildlife Habitat Gardening, Waterwise Gardening, and use of native landscape plants in suburban gardens; (7) Human Activities and the Natural Environment - coupled environmental and socioeconomic modeling methodologies will highlight interactions between human activities (drivers), environmental impacts from those activities (stressors), potential changes to valued ecosystem components, and feedbacks experienced from the changes; (8) Wildlife Management - effects of human activity on migratory shore birds, box turtles in suburban habitat fragments, neotropical bird migrants in Delaware, Bobwhite quail in warm season grasslands, horseshoe crab ecology in the Delaware Bay, insect biomass production in suburban habitats, habitat restoration for bats and White-tailed deer populations and lead to recommendations for improved habitat management; (9) Fisheries - population status, spawning areas, and management of Atlantic sturgeon in the Delaware River.

2. Brief description of the target audience

Farm owners and operators, aquaculture producers, recreational fisheries, seafood consumers, water quality managers, agribusiness and private consultants, horticultural professionals, city land use planners and other policy-makers, home gardeners, childcare providers, environmental educators.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	1000	1000	850	850
Actual	17494	1677	1790	103

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total

Plan	2	12	
Actual	2	21	23

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	8	48

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	3	25

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	3	31

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	12	74

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	6	43

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2009	3	6

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	2	0

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	14	23

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	3	8

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	8	13

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	6	60

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	18	59

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	20	115

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	9

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	4	129

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.
2	Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.
3	Establish a Center for Managed Ecosystems to conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.
4	Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.
5	Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.
6	Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.
7	Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.
8	Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.
9	Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.
10	Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

Outcome #1

1. Outcome Measures

Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Establish a Center for Managed Ecosystems to conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Landowners, government agencies, not-for-profits, and the public who are interested in how natural resource areas can contribute to alternative energy production.

What has been done
Educational programs on agricultural and forestry sources of biomass energy were conducted for legislators

Results
The Governor's Energy Advisory Council concluded a 12-month effort to develop the next 5-yr. Delaware Energy Plan. UD represented agriculture & forestry interests as a member of one working group resulting in 'biomass energy' being included in the Plan as a 'high priority' recommendation for legislative change or adoption, while establishing potential economic opportunities for DE agriculture & forest landowners.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
903	Communication, Education, and Information Delivery

Outcome #10

1. Outcome Measures

Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Landowners, government agencies, and the public concerned about the negative ecological impacts of invasive plants and animals.

What has been done
Education and training programs on the ecological problems caused by invasive plants; research on the use of beneficial insects to eliminate invasive plants from natural ecosystems.

Results
Research in the area of native plants and sustainable landscaping is a growing area at UD. During this reporting period, the University of Delaware Botanic Gardens and associated faculty developed a sustainable landscapes website. In addition, UDBG and UD faculty members worked with UD grounds and facilities to install sustainable landscaping on the campus, restore sites as appropriate, and provide guidance for sustainability. UD faculty members traveled throughout the country to promote the use of native plants. Research at UD shows release of the Asian mile-a-minute weevil substantially reduced mile-a-minute weed populations at several sites. Weevils established at 97% of sites released, and dispersed an average of 4.3 km per year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

FAMILY AND YOUTH DEVELOPMENT

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
801	Individual and Family Resource Management	20%	20%	20%	20%
802	Human Development and Family Well-Being	20%	20%	20%	20%
806	Youth Development	40%	40%	40%	40%
903	Communication, Education, and Information Delivery	20%	20%	20%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	21.6	4.0	0.0	0.0
Actual	17.4	3.4	0.0	1.5

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
122043	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
482426	0	63900	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1477049	0	10020	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Volunteer Leadership Development programs will be delivered on public policy education; volunteer leadership development (e.g., 4-H adult and teen volunteers and camp counselors, master gardeners, master food educators; T.R.Y. (Teens reaching youth), middle management volunteers (volunteers managing volunteers); and extension advisory committees; (2) Family Well-Being Across the Lifespan Educational Programming, including Just in Time Parenting (Great Beginnings and the Brown Bag program for parents of young children) and Families Matter! (for parents of school-age children), interactive web sites, newsletter series, workshops, worksite seminars and classes focusing on positive parenting and care giving, family stress management, child development, healthy relationships and marriage education, savvy

decision-making, anger management and conflict resolution, healthy communication, intergenerational well-being, teamwork, leadership, and community involvement skills; 3) Safe Communities - programs will include drug and alcohol prevention education, bicycle safety education, pedestrian safety education, farm safety, and car seat safety; (4) Family Economic Well-Being and Consumer Decision Making educational programs will be developed and delivered focusing on strategies for effective consumer decision making, financial planning, financial management counselor training, basic budgeting, credit management, and retirement planning; (5) 4-H Youth Development programs will focus on life skills development, positive life choices, leadership development, citizenship/community involvement, and career exploration with emphasis on science, engineering and technology knowledge. Appropriate settings including clubs, camps, school enrichment and after school will use the latest technology to deliver the sustained opportunities.

2. Brief description of the target audience

Youth ages 5-19, 4-H members, 4-H volunteers, new 4-H volunteers, Master Gardeners, Community Leaders, at-risk youth and families, court appointed and incarcerated youth and adults, parents of children (from birth through school-age), families with members in the second ½ of the lifespan, youth agency professionals, key decision-makers, human service professionals, child care/after school providers, family day home providers, social clubs, church groups, private and public school youth and teachers, after school 4-H clubs and school age child care programs.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	7600	214550	50300	2200
Actual	36822	80995	57853	21790

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	1	0	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	15	39

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	5	24

Output #3

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	12	77

Output #4

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	12	74

Output #5

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	35	133

Output #6

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	10

Output #7

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	160	647

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.
2	Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedeness to their future careers.
3	Educational programming for K-12 teachers and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.
4	Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances.
5	Number of youth participating in extension programs who demonstrate improved academic, social, and job preparedness skills.
6	Number of parents/families participating in extension programming who demonstrate positive parenting skills.
7	Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills
8	Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families
9	Number of youth and adults adopting bike, pedestrian and traffic safety rules and regulations.
10	Dollars saved through volunteer interventions.
11	Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.
12	Number of adults adopting best practices in child development, business development, educational program development in child care settings.
13	Number of youth who have increased science, engineering, and technology skills.
14	Number of youth with greater involvement in citizenship and community service programs.
15	An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement.

Outcome #1

1. Outcome Measures

Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedeness to their future careers.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Educational programming for K-12 teachers and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Number of youth participating in extension programs who demonstrate improved academic, social, and job preparedness skills.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Number of parents/families participating in extension programming who demonstrate positive parenting skills.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Parents, government agencies and not-for-profits concerned about parenting and families.

What has been done
Statewide newsletters on parenting skills were distributed providing valuable guidance on youth and family development for parents.

Results
Just in Time Parenting is a newsletter produced and distributed to readers throughout Delaware. Just in Time Parenting readers across all educational and economic levels report that they feel more confident and competent in raising their children, and that JITP newsletters are more useful than any other source of information. Just in Time Parenting helps parents have realistic age-appropriate expectations; provides reassurance about their child's development; accentuates the positive - encourages and reinforces family's strengths; helps parents identify problems early; suggests how to find help; links parents to a broad range of human services; reaches "hard to reach" families; cuts through social isolation of abusive families; is a cost-effective way to get high quality parenting information to families, increasing the chances that every child will grow up healthy and ready for success; complements and enhances face-to-face and community-based outreach to parents.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Military agencies, families, not-for-profits, and state/federal agencies interested in youth and family development for military families.

What has been done
Educational programs for youth from military families were conducted to help children have healthier, stable lifestyles.

Results
The UD's 4-H Operation Military Kids program filled and distributed over 719 Hero Packs to military youth in 2009. The mobile tech lab was used at 82 events in 2009 reaching 6,000 youth. 36 camps were offered to 1232 military youth and 305 adults OMK display was set up at 82 events reaching over 10,000 people. 60 military youth were trained in the 4-H/Army Babysitter Curriculum in 2009 so that they could help take care of younger siblings while their parent is deployed. They also learned about healthy cooking/exercise and the importance it plays in our lives.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adults, families, health care providers, and government agencies

What has been done
Health-oriented programs were conducted for retirees and senior citizens, emphasing mental acuity skills.

Results
In collaboration with the Retired Senior Volunteer Program, Del Tech Adult Plus program presented the Living a Brain Healthy Lifestyle conference. It was a statewide offering in 2008 and we coordinated the Sussex County portion of the program. The program was offered to older individuals, many of whom were retired. Over 100 Sussex Countians attended the program presented at Del Tech. Ten vendors offered information, the attendees participated in Wii programming and Dr. Paul Nussbaum, speaking from Clayton Hall, presented information on how to keep your brain healthy and why it is important.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Number of youth and adults adopting bike, pedestrian and traffic safety rules and regulations.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #10

1. Outcome Measures

Dollars saved through volunteer interventions.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
903	Communication, Education, and Information Delivery

Outcome #11

1. Outcome Measures

Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
903	Communication, Education, and Information Delivery

Outcome #12

1. Outcome Measures

Number of adults adopting best practices in child development, business development, educational program development in child care settings.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Childcare providers are in need of regular training in a range of pressing areas related to families, childcare, and youth development.

What has been done
Extension FCS educators provided training to childcare providers through conferences presentations and monthly workshops offered in each of Delaware's counties. Topics are determined through needs assessments, required course topics, and new research findings. FCS educators develop, implement and market the programs and have partnered with child care centers and area family day care support groups to provide training. We have been a part of statewide training conferences

Results

Two hundred and twenty-one clock hours of childcare provider training was offered to over 7860 (750 unduplicated) childcare providers. It is estimated that over 12,000 children were impacted by the programs that offered. All programs are approved through Delaware First Office of Child Care Licensing and are part of the requirements for licensure as a childcare business.
Each month during the year in each county a 2-3 hour program is offered. In addition, specialty programs may be offered to local support groups or on Saturdays to reach a different audience. Examples of the types of topics include: Emergency Preparedness, Improving Transition Times with Children, Food Allergies, I Want, I Want I want... Building Good Consumers, What Does Time Mean to Children, Boning Up On Health- Understanding Osteoporosis, Sparking Kids Curiosity, Art Appreciation for Children, Fire Safety, Making the Most of your Money, Child Passenger Safety, Working with Military Families, Program Management, Videography in the Classroom, Managing Behavior in your Classroom, Managing Children with Behavioral Challenges, and Healthy Snacking.

In addition, Cooperative Extension was part of the "Supporting Quality Afterschool for All Delaware's Youth full day conference held in May 2009 reaching 205 individuals. Fifty two providers attended the Introduction to School Age Child Care training during FY09 as the required course for first time employees working with school age youth in camps and afterschool programs. Tools of the Trade reached 60 providers assisting them in program management and curriculum development.

After each session, child care providers are surveyed.. For almost every program offered 90% or more of respondents indicate that they will take away at least one best practice that they will implement in their setting.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #13

1. Outcome Measures

Number of youth who have increased science, engineering, and technology skills.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #14

1. Outcome Measures

Number of youth with greater involvement in citizenship and community service programs.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #15

1. Outcome Measures

An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

FOOD SCIENCE, TECHNOLOGY, SAFETY, AND NUTRITION

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	20%	20%	20%	20%
502	New and Improved Food Products	5%	5%	5%	5%
702	Requirements and Function of Nutrients and Other Food Components	5%	5%	5%	5%
703	Nutrition Education and Behavior	20%	20%	20%	20%
704	Nutrition and Hunger in the Population	10%	10%	10%	10%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%	20%	20%	20%
724	Healthy Lifestyle	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	2.0	4.4	4.0
Actual	8.8	3.6	3.9	2.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
13617	0	4707	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
76751	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
534345	0	309126	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research efforts involve using high pressure processing to reduce bacteria, viruses, protozoan oocysts, and bacterial endospores; inactivation of pathogenic bacterial species with high pressure and mild heat; using various antimicrobial films to control bacteria, such as Listeria monocytogenes; physiological and genetic analysis of pressure-resistant Listeria monocytogenes; testing of activity of antimicrobial films against native and inoculated bacteria on foods and surfaces; effects and mechanisms of non-thermal processes (ozone, UV, oxidative chemicals, iron, and/or high pressure processing) on protozoa, human pathogenic viruses, and bacteriophage, and increase understanding of basic biochemistry of these microorganisms. Extension efforts include conducting Keep Food Safe, ServSafe®, Don't Give Kids a Tummy Ache, Food Safety for Entrepreneurs, Keep'em Down on the Farm, Chances and Choices, Operation Risk, Microbial Contamination, Don't Bug Me!, Families First Nutrition Education and Wellness System (FFNEWS), Power of Choice, Dining With Diabetes, Give Your Heart A Healthy Beat!, Boning Up On Health, Strive For 5, Intelligent Eaters Club, Dietary Effects On Cancer Risks, Stretch, Flex, And Endure, Snacks to Please!, Planning Meals for Children, Create A Healthy Environment, Putting Good Nutrition To Work for Children, FoodSkills, and Expanded Food and Nutrition Education workshops; training volunteers including Master Food Educators, 4-H leaders, agency personnel, and teachers; providing Great Beginnings and Families Matter newsletters; publishing a quarterly nutrition newsletter for general audiences and giving handouts to parents of children in targeted schools as well as to other school personnel; developing and delivering programs on Kids Cooking (1890 EFNEP), Food Safety for Youth, Eat Smart, Play Hard, and Diet and Cancer; conducting favorite foods and 4-H foods contests; developing web-based information and fact sheets; distributing information to media; developing a marketing campaign to expand program participation; developing a marketing strategy with state and local government partners, faith-based groups, parents, social workers, childcare providers, low income housing managers, and corporate wellness centers to collectively deal with low income and socially disadvantaged individuals.

2. Brief description of the target audience

Restaurant workers, volunteer food handlers, delicatessen workers, day care providers, institutional foodservice workers, school foodservice personnel, caterers/private chefs, food entrepreneurs, retail food owners/managers, food producers, youth ages 5 to 18, parents and caregivers of children from birth to 18, limited-resource individuals and families, 4-H leaders and clubs, Boys and Girls clubs, teachers and other school personnel, youth in low-income schools, adults at risk for chronic disease (diabetes, osteoporosis, heart disease, certain cancers), adults with chronic diseases (diabetes, heart disease) policy makers, and media.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	3270	46580	6750	7245
Actual	6486	322	9516	5000

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	1	6	

Actual	1	21	22

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	6	37

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	2	10

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	4	5

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	3	11

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	4	14

Output #6

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	1	0

Output #7

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	7	22

Output #8

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	1	3

Output #9

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	1	2

Output #10

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	12	62

Output #11

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	3	113

Output #12

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	10	96

Output #13

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	4

Output #14

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	225	312

Output #15

Output Measure

- Number of Newsletters Distributed

Year	Target	Actual
2009	34000	2204

Output #16

Output Measure

- Number of New Program Partners

Year	Target	Actual
2009	20	10

Output #17

Output Measure

- Number of Ph.D. Students

Year	Target	Actual
2009	{No Data Entered}	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.
2	Educational programs for K-12 youth and teachers on food safety and nutrition that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.
3	Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.
4	Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.
5	Increased number of program participants improving in one or more safe handling practices.
6	Increased number of participating youth increasing understanding of safe food handling procedures.
7	Increased number of program participants improving one or more nutrition practices.
8	Increased number of program participants improving one or more food resource management practices.
9	Increased number of program participants increasing or maintaining appropriate physical activity level.
10	Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.
11	Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

Outcome #1

1. Outcome Measures

Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on food safety and nutrition that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased number of program participants improving in one or more safe handling practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area

501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Increased number of participating youth increasing understanding of safe food handling procedures.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Increased number of program participants improving one or more nutrition practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
State and federal governments, health care organizations, families, and others concerned about food safety, nutrition, and health.

What has been done
Training sessions for volunteers assisting in nutrition and safety programs, educational programs on serving safe food, eating for a healthy heart, and dining with diabetes.

Results
Americans face many challenges related to food safety and nutrition. Complex issues associated with the role of diet in prevention of chronic diseases such as heart disease and cancer, childhood obesity, and safe food preparation practices often require knowledge and skills that consumers lack. To address these concerns family and consumer science (FCS) educators with Extension deliver many high-quality, cutting edge programs; however, there are too few staff to adequately meet the needs of Delawareans.

An intensive 30 hour course in nutrition and food safety was developed to provide volunteers with the tools to either assist FCS staff or deliver basic programs in New Castle County. Both technical background information and hands-on experiences were included in the training. Participants successfully completing the training are designated as Master Food Educators (MFEs). Results: Eight individuals participated in the classes in the fall of 2009. For the 30 hours of training, each participant agreed to give back 45 hours of volunteer time. In the first four months after completing training, seven MFEs have volunteered 105 hours to Extension. Examples include assisting with Eat Smart for a Healthy Heart, judging a 4-H favorite foods competition, and staffing both food safety and nutrition displays for a public event.

In Sussex County, 47 individuals attended either the ServSafe certification classes or Dine Safe programs. Approximately 3000 youth participated in presentation on proper hand washing procedures. Additionally, 60 growers in Sussex County participated in the Farm Food Safety certification programs offered in spring 2009.

Overall, ServSafe participants reported confidence in cooking foods to the proper temperature. Eat Smart for a Healthy Heart participants reported being more knowledgeable in preparing food using less fat. Dining with Diabetes participants reported more understanding in controlling carbohydrate consumption.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Increased number of program participants improving one or more food resource management practices.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Increased number of program participants increasing or maintaining appropriate physical activity level.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #10

1. Outcome Measures

Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #11

1. Outcome Measures

Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agencies and organizations seeking science-based solutions to applied problems related to food safety.

What has been done
Educational programs on food safety were conducted statewide and a food safety certification program was established for commercial vegetable growers, farm workers, and produce handlers.

Results
UD professionals led a team to implement educational programs for produce food safety (Good Agricultural Practices, Good Handling Practices, Produce Food Safety Plans, and Passing Third Party Audits for produce food safety) for commercial vegetable growers. This included bringing Agriculture and FCS extension staff together to plan; bringing in produce food safety curriculum from NC State, Rutgers, and Cornell to evaluate; communicating directly with colleagues in other states who are conducting these trainings; setting up session at Delaware Ag. Week on these topics; organizing and delivering 6 hours of training for wholesale produce growers and 3 hours of training for direct marketers and small growers at multiple locations. UD worked with the DDA to issue a voluntary certification for those that attended the trainings. UD also secured funding from DDA to support this educational push and serves as a co-project director on another grant that has been submitted to support continued training in produce food safety. This is $31,000 of funding. Over 140 clients have gone through training so far. Over 80 farm workers have been trained and 3 mock audits done on farm. UD also worked with the Produce Marketing Association to set up a tour for the FDA commissioner and key food safety staff on Delaware produce farms and a forum with the commissioner and staff to discuss key produce food safety issues from a grower's perspective.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
702	Requirements and Function of Nutrients and Other Food Components
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

PLANT BIOLOGY AND CROP PRODUCTION SYSTEMS

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	30%	30%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%	10%	10%	10%
205	Plant Management Systems	20%	20%	10%	10%
206	Basic Plant Biology	10%	10%	15%	15%
212	Pathogens and Nematodes Affecting Plants	10%	10%	5%	5%
213	Weeds Affecting Plants	10%	10%	5%	5%
216	Integrated Pest Management Systems	10%	10%	5%	5%
402	Engineering Systems and Equipment	5%	5%	5%	5%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	12.6	1.0	23.7	6.0
Actual	13.7	1.4	23.2	3.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
364270	0	426081	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
648204	0	248735	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
440900	0	516820	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Agronomic, Vegetable and Horticultural Crop Production - improving varietal selection, disease and pest resistance, seed technology, cultural production practices, and marketing practices and skills for the many and diverse types of crop producers in Delaware; (2) Culinary Herbs and Essential Oils - management practices for propagation of plants of flavor, fragrance, and medicine will be developed and techniques for production, harvesting, and distillation will be demonstrated and disseminated; the Herb Research Center, along with the Claude E. Phillips Herbarium, will continue to analyze living plants, dried botanicals, and essential oils to help small farmers, processors, and distributors of these products when they otherwise have no means of certifying their products as safe in the American food supply; a national collection scheme of living herbs will be continued, as formulated under the aegis of the Herb Society of America, to not only preserve germplasm but also to provide correctly labeled material to gardeners, farmers, nurseries, and researchers. We will also continue to be the primary source of information on herbs and nomenclature for a worldwide audience, including manufacturers of culinary herbs and dietary supplements; (3) New Crops - financial and environmental impacts of growing new varieties of existing crops (Fordhook lima beans), new crops (greenhouse vegetables, crowder peas, garbanzo beans), horticultural varieties (herbaceous perennials), and turfgrass will be investigated. The potential of organic production of crops for processing will be evaluated; (4) Value-added Agricultural By-Products - we will evaluate the feasibility of using agricultural by-products (crop residues, manures, municipal composts, yard wastes, biosolids, and industrial materials) for fuel, feed, and litter for poultry houses; (5) Integrated Pest Management - improved methods for control of insect pests, weeds, and plant pathogens, understanding pesticide movement and interactions within the soil, and identifying herbicide combinations that improve weed control and reduce active ingredient application are priorities; (6) Nutrient Management - nutrient recommendations and nutrient management best management practices will be reviewed and research will be targeted at improving the efficiency of nitrogen and phosphorus use by agronomic, vegetable, and horticultural crops will be priorities; (7) Engineering Technologies - improvements in mechanical harvesting and automated guidance systems for harvesters will be sought and water resource protection will be enhanced by research on irrigation management and will develop irrigation scheduling strategies that are effective and easy to implement. Advances in remote sensing, tillage, and pesticide application are emerging research priorities; (8) Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics to Genetically Engineer Plants - research that improves our understanding of plant genomes and the application of genomic information for crop improvement and crop protection will be continued and expanded. Basic studies on how plants adapt to their environments and manage stress, including disease, will be conducted. Studies that address soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions, such as rhizosphere effects, to enhance crop growth and quality will be undertaken. The feasibility of growing genetically engineered crops and greenhouse plants in Delaware will be evaluated; (9) Urban/Suburban Horticulture - developing guidelines for safe establishment of community gardens in impoverished neighborhoods will be a priority, particularly for areas where soils may be contaminated by heavy metals such as lead and arsenic; demonstration gardens, workshops, and training programs for agriculture science teachers will focus on landscape diversity, exotic invasive species, water quality and conservation; (and 10) Pasture and Forage Management - research on animal production systems in pastures will expand with an emphasis on meat goats and beef cattle and forage research will emphasize improving biological control systems for alfalfa.

2. Brief description of the target audience

Existing and prospective crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, trade associations (e.g., Delaware Herb Growers & Marketers Association), the "green industry" (e.g., horticulture, nurseries, landscapers), certified crop advisors, private agricultural consultants, state (DDA, DNREC, DELDOT) and federal agencies (USDA), national laboratories (e.g., Argonne), chemical/seed/fertilizer companies, agricultural equipment companies, peer scientists, growers, processors, marketers of plants of flavor, fragrance, and medicine in Delaware, educators, policy-makers, the U.S., and international countries.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	5040	11625	1350	3750
Actual	13412	46886	4093	265

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 1
Actual: 1

Patents listed
High Lift Mower for Plastic Mulch

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	5	27	
Actual	3	11	14

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	14	44

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	4	20

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	3	19

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual

2009	6	15

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	5	16

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2009	8	9

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	5	4

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	32	14

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	3	6

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	16	42

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	50	33

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	40	64

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	55	83

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	8

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	25	80

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of farmers, other producers, and land managers aware of latest advances in cultural management practices, crop varieties, irrigation technologies, and integrated pest management strategies for agronomic, vegetable, and horticultural crop production.
2	Targeted educational programs for farmers focused on cultural practices, marketing, and environmental aspects of new, high value cropping systems for niche markets, such as culinary herbs and essential oil plants, greenhouse grown pharmaceutical and nutriceutical plants, and plants grown as renewable bioenergy sources.
3	Educational programs for K-12 teachers and youth on advances in plant molecular biology and applications of the basic plant sciences to the production of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes.
4	Increased adoption of new innovations in marketing and risk management for farmers and other producers of plants and plant-based products.
5	Increased number of farmers adopting new crop varieties and integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into their production systems.
6	Increase in the number of farmers implementing comprehensive nutrient management plans that are profitable and protective of ground and surface water quality.
7	Increased adoption of recommended practices for plant production, management, and environmental protection by the "Green Industry" (greenhouses, nurseries, landscapers).
8	Increased amount of land used to produce high value, niche market crops, such as culinary herbs, spices and essential oils.
9	Expansion in amount of land and increased adoption of best management practices for pasture and forage production systems for the beef, goat, and equine industries.
10	Commercial scale feasibility studies of greenhouses to produce high value plants that have been genetically modified, such as those intended for pharmaceutical or nutriceutical uses.
11	Plant Biology: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses.
12	Agronomic and Vegetable Crops: applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality.
13	Horticultural Systems: Extension programs will provide guidance on management practices for horticultural plants produced and installed by the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.
14	New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.

Outcome #1

1. Outcome Measures

Increased number of farmers, other producers, and land managers aware of latest advances in cultural management practices, crop varieties, irrigation technologies, and integrated pest management strategies for agronomic, vegetable, and horticultural crop production.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, crop consultants, state and federal agricultural agencies, and the public.

What has been done
Regional training on crop management was conducted and the economic value of the training to crop consultants was determined. Nationally recognized fact sheets on Japanese apple rust were developed.

Results
UD collected economic impact data from a survey of participants at the Mid-Atlantic Crop Management School. The school represented 1,746.5 years of consulting experience which was up from the 875 years in 2008 which had been way down from the 1,179 years in 2007, 989.5 years in 2006 and similar to the 1,178 years in 2005 and the 1,337 years in 2004 and 2003. Of those responding, 96 percent said that the information presented at the school will help them provide better crop management advice to their clientele (slightly higher than in the previous years). The respondents said that they consult or advise on a total of 797,000 acres up significantly from the reported 491,900 acres in 2008, the 512,641 acres in 2007, 281,255 acres in 2006, 580,800 acres in 2005, and 478,620 acres reported in 2004.

Economic impact of the school was calculated based on the responses to a question on the questionnaire regarding the value of the information the consultants or growers obtained from the school. This year there were 40 (37% of respondents answering the questions on the first two pages of the survey) respondents that listed a dollar amount per acre plus another five who said it would have an impact but were unable to provide an estimated dollar value. This percentage was very similar to that seen in previous years and in part is due to the number of government employees (NRCS, Extension, etc.) attending that do not directly consult as the corporate CCA's do. Based on the average given by 40 respondents, the impact of the school was approximately $25.36 per acre which is very similar to that reported in 2008 ($26.67 per acre), in 2007 ($29.17 per acre), in 2006 ($19.10 per acre), and in 2005 ($27.50 per acre).

In 2009 based on the total number of acres reported, the economic impact of the school to the farming community is $20,225,075. If we calculate it only on where a consultant reported both acreage and a dollar per acre impact estimate, the economic impact of the school was $8,942,200. This can be compared with the 2008 estimate

based on the number of acres reported with a dollar amount specified of $13,117,333 versus $15,237,000 in 2007 and versus between $4,961,400 and $5,400,096 in 2006 with a per acre impact of $19.20/acre.

A fact sheet was developed in cooperation with USDA/APHIS/PPQ for Japanese apple rust, a new disease in the US. Following distribution of the fact sheet, a number of other detections were made in the Eastern US. This was a success story for the National Plant Diagnostic Network, highlighted at their national meeting.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Targeted educational programs for farmers focused on cultural practices, marketing, and environmental aspects of new, high value cropping systems for niche markets, such as culinary herbs and essential oil plants, greenhouse grown pharmaceutical and nutriceutical plants, and plants grown as renewable bioenergy sources.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area

205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Educational programs for K-12 teachers and youth on advances in plant molecular biology and applications of the basic plant sciences to the production of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased adoption of new innovations in marketing and risk management for farmers and other producers of plants and plant-based products.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, state and federal agencies, banks and other financial institutions investing in agriculture.

What has been done
E-marketing club was established and grain marketing conferences were held.

Results
UD conducted an e-grain marketing club, workshops, and a yearly grain marketing strategies conference. As a result, grain producers now have a better understanding regarding the use of their grain marketing alternatives

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased number of farmers adopting new crop varieties and integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into their production systems.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, state and federal agencies, financial institutions investing in agriculture, and groups concerned about efficient use of fertilizers and pesticides.

What has been done
On-farm demonstrations to reduce production costs for grain and vegetable farmers.

Results
In working with several grain and vegetable farm operations, UD professionals were able to assist these producers in reducing costs of production in the areas of fertilizer, pesticide, and irrigation management. Estimated savings to these producers was over a 1/2 million dollars cumulative.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
402	Engineering Systems and Equipment
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Increase in the number of farmers implementing comprehensive nutrient management plans that are profitable and protective of ground and surface water quality.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Increased adoption of recommended practices for plant production, management, and environmental protection by the "Green Industry" (greenhouses, nurseries, landscapers).

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done

{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Increased amount of land used to produce high value, niche market crops, such as culinary herbs, spices and essential oils.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Expansion in amount of land and increased adoption of best management practices for pasture and forage production systems for the beef, goat, and equine industries.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #10

1. Outcome Measures

Commercial scale feasibility studies of greenhouses to produce high value plants that have been genetically modified, such as those intended for pharmaceutical or nutriceutical uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #11

1. Outcome Measures

Plant Biology: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

Outcome #12

1. Outcome Measures

Agronomic and Vegetable Crops: applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers, crop consultants, state and federal agricultural agencies, environmental agenices and groups concerned about efficient water use and crop production.

What has been done
A system to evaluate and improve irrigation efficiency was implemented on farms; a new technology to address crop residue problems for vegetables grown on plastic mulch was developed and tested on farms.

Results
UD developed and expanded an irrigation system evaluation for improving the uniformity and efficiency of agricultural irrigation systems. In addition, they designed, fabricated and tested a system for removing waste plant material from crops grown on plastic mulch, followed by a machine for the collection, cleaning and condensing (baling) of waste plastic mulch and drip tape for recycling. A patent has been obtained for the high lift plastic mower and one is expected for the plastic baler.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #13

1. Outcome Measures

Horticultural Systems: Extension programs will provide guidance on management practices for horticultural plants produced and installed by the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done

{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #14

1. Outcome Measures

New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

RURAL DEVELOPMENT AND LAND USE CHANGE

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	20%	20%	5%	5%
131	Alternative Uses of Land	20%	20%	30%	30%
605	Natural Resource and Environmental Economics	10%	10%	30%	30%
608	Community Resource Planning and Development	20%	20%	10%	10%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	10%	10%	10%	10%
805	Community Institutions, Health, and Social Services	10%	10%	5%	5%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	4.1	0.0	9.1	0.0
Actual	3.3	0.2	8.3	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
165296	0	243465	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
31857	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1067618	0	98875	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target: (1) Rural Revitalization and Community Development - the process of change in rural economies will be monitored and opportunities for rural revitalization and community development identified; (2) Individual Academic and Family Financial Success - factors that encourage individual academic and family financial success will be identified and strategies developed to enhance those assets; (3) Social and Economic Development for All Family Members - programs to assist communities in building the social and economic capital important for civic, social, emotional and educational development of all family members including youth and the elderly will be developed and delivered; (4) Economic Growth for Rural Communities - business expansion and retention strategies for rural communities that encourage and/or manage economic growth will be developed and delivered; (5) Minimizing Land Use Conflicts and Protecting Natural Amenities - strategies to minimize land use conflicts and protect natural amenities in an urbanizing environment will be investigated, including use of integrated conceptual models that aid those responsible for resource management decisions; (6) Benefits and Costs of Alternative Surface and Ground Water Quality Protection - a framework will be developed to examine the economic benefits and costs of alternative approaches to protect surface and ground water quality; (7) Protection and Preservation of Agricultural Land - current strategies to protect and preserve agricultural land will be evaluated and promising new approaches will be investigated and assessed; (8) Rural Communities - social and economic structures of rural communities will be studied and used to formulate strategies for sustainable development; (9) Training Programs - Training programs in land use change will be developed and delivered to provide farmers, landowners, and community members decision-making tools for land use and preservation issues; (10) Critical Mass and the Urban Interface - the economic, social and cultural impacts of land fragmentation, increased spatial interfaces with urban uses and effects on agricultural support industries will be used to assess the necessary "critical mass" for future agricultural viability; and the web of relationships between urban and rural land uses will be documented.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources and Environmental Control; Department of Transportation; Economic Development Office), federal agencies (USDA, NRCS, USEPA), land use organizations (Conservation Districts, AFT), environmental organizations, business and community leaders, families, students, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	4000	8000	300	600
Actual	3011	7174	350	850

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	1	5	
Actual	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	4	14

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	2	8

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	2	5

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	4	6

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	5	13

Output #6

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	6	8

Output #7

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	1	2

Output #8

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	3	3

Output #9

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	3	2

Output #10

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	3	7

Output #11

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	5	10

Output #12

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	2

Output #13

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	4	34

Output #14

Output Measure

- Number of Ph.D. students

Year	Target	Actual
2009	{No Data Entered}	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Rural families and communities will be provided with the knowledge and skills needed to adapt to the changing social, economic, and political conditions associated with conversion of agricultural land to suburban and urban land uses.
2	Educational programs for K-12 teachers and youth on the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.
3	Increase in the number of rural families participating in extension education programs on preparing for academic success, identifying new career options, and family financial planning.
4	Increased training for rural families in establishing and achieving success with small businesses in rural, agricultural situations and in settings where land use change creates new economic opportunities beyond agriculture.
5	Increased number of farmers and other landowners trained in the social, political, economic, and environmental aspects of land use change and farmland preservation.
6	Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.
7	Rural Development: extension programming will provide rural families and communities with the personal, educational, social, and financial skills needed to thrive economically during a period of changing land use. These programs will sustain traditional agribusinesses that now support rural families and communities; identify new economic opportunities as land use changes; and assist rural communities and families in building the social and economic capital needed for success.
8	Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will help to guide long-term land use planning in cooperative efforts

Outcome #1

1. Outcome Measures

Rural families and communities will be provided with the knowledge and skills needed to adapt to the changing social, economic, and political conditions associated with conversion of agricultural land to suburban and urban land uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 teachers and youth on the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Increase in the number of rural families participating in extension education programs on preparing for academic success, identifying new career options, and family financial planning.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Women in agriculture, risk management agencies and not-for-profits, state and federal agencies.

What has been done
Risk management training for university personnel and partnerships established with Women and Working Lands group.

Results
UD professionals attended the Women and Working Lands Group meeting in Washington, D.C. Since that meeting, the Women and Working Lands Group requested to collaborate with the Northeast Center for Risk Management Education (at UD) to hold a post-conference (National Women in Agriculture Educators Conference) seminar. UD was awarded $74,500 by way of a Cooperative Agreement from USDA-RMA in an effort to support this seminar and to provide risk management/crop insurance education through the Conference program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
805	Community Institutions, Health, and Social Services
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased training for rural families in establishing and achieving success with small businesses in rural, agricultural situations and in settings where land use change creates new economic opportunities beyond agriculture.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased number of farmers and other landowners trained in the social, political, economic, and environmental aspects of land use change and farmland preservation.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farm families, state and federal agencies involved in Farm Bill programs.

What has been done
Farm bill training for farmers and farm families

Results
UD cooperated with Delaware Farm Service Agency offices to educate farm producers about the Farm Bill. As a result of their efforts, Delaware is ranked 7th nationally in the percentage of eligible acres enrolled in Farm Bill programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
131	Alternative Uses of Land

605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Rural Development: extension programming will provide rural families and communities with the personal, educational, social, and financial skills needed to thrive economically during a period of changing land use. These programs will sustain traditional agribusinesses that now support rural families and communities; identify new economic opportunities as land use changes; and assist rural communities and families in building the social and economic capital needed for success.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will help to guide long-term land use planning in cooperative efforts

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Local communities, state and federal agencies involved in land use planning, farmers, developers, land-owners, not-for-profit groups concerned about land use.

What has been done
A coastal community enhancement intiative continues to address issues realted to land use, growth, environment, and agriculture in Delaware's coastal regions.

Results
UD-CANR is partnering with UD's College of Earth, Ocean, and the Environment, and the College of Education and Public Policy in the Coastal Community Enhancement Initiative Land Use Planning tool. This initiative is an approach to address growth, land use, and environmental impacts in southern Delaware. A key aspect of CCEI during this reporting period was work in the area of heritage tourism. UD hosted a heritage tourism workshop held at UD's Elbert N. and Ann V. Carvel Research and Education Center in Georgetown, Del. Sussex County town managers, members of historical societies and chambers of commerce, and representatives of local businesses attended to collaborate on ways to develop a heritage tourism industry for southern Delaware. Heritage tourism is quickly emerging as major trend. According to research, a typical heritage tourist will plan three trips a year, and has a special appreciation for authentic experiences, artifacts and activities of a region's past. Community leaders, organizations and businesses are asked to be key actors in developing the strategic marketing of lesser known, charming locations and bringing attention to the elements that comprise Delaware's unique heritage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

131	Alternative Uses of Land
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- Before-After (before and after program)
- During (during program)
- Case Study
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

SOILS AND ENVIRONMENTAL QUALITY

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	5%	5%	5%	5%
102	Soil, Plant, Water, Nutrient Relationships	30%	30%	25%	25%
104	Protect Soil from Harmful Effects of Natural Elements	5%	5%	5%	5%
112	Watershed Protection and Management	15%	15%	10%	10%
133	Pollution Prevention and Mitigation	15%	15%	25%	25%
141	Air Resource Protection and Management	5%	5%	5%	5%
403	Waste Disposal, Recycling, and Reuse	15%	15%	15%	15%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	4.6	0.0	15.6	2.0
Actual	4.7	0.3	17.9	1.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	5409	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
244073	106648	106648	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
92043	0	1823659	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Fate, Transport, and Reaction Mechanisms - understanding the fate, transport and reaction mechanisms of plant nutrients (nitrate, phosphate), metals (copper, chromium, arsenic, mercury, other heavy metals), wastes (manures, sludges, industrial by-products and co-products) and organic chemicals (pesticides, industrial organic chemicals) in soils and soil components, and their effects on soil and water contamination using multi-spatial and multi-temporal scale approaches; (2) Cost-Effective, In-Situ Remediation - developing cost-effective, in-situ methods for the remediation and speciation of contaminated soils, including phytoremediation, bioremediation, and atomic and molecular approaches. Molecular environmental and biological approaches will be applied to study the mechanisms used by plants to take up, transport, and tolerate metals. Emphasis will be placed on the role of plant/soil/microbial interfacial reactions on contaminant accumulation and bioavailability; (3) Nutrient Management/Water Quality/Air Quality - develop fertilizer and waste management programs that ensure economic and environmental sustainability while considering crop needs, soil fertility, application technology, alternative fertilizer sources, and government policies. Research on non-point source pollution of surface and ground water by nutrients will continue. Best management practices for phosphorous will be developed with animal scientists, soil scientists, hydrologists, and environmental engineers. Education/certification programs in nutrient management and water quality will continue. Research on air emissions from poultry operations and methods to control these emissions will be started. (4) Irrigation Water Management &ndash continue extension education and demonstration programs on more efficient water management practices.

2. Brief description of the target audience

Crop producers, poultry growers, state agencies (DDA, DNREC), federal agencies (USDA, USGS, EPA, NSF, DOE), environmental groups, peer scientists, industries with soil contamination problems, and commodity groups.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	2000	3000	300	600
Actual	9323	12789	1470	550

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	4	30	
Actual	1	30	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2009	26	40

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2009	8	22

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	4	25

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2009	8	23

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2009	4	14

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2009	18	15

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2009	3	7

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	34	31

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2009	5	4

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2009	20	12

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	28	7

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2009	70	20

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	110	59

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2009	0	7

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	40	76

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Soil management programs and best management practices for soil use in agricultural, natural, suburban/urban, and disturbed or contaminated settings will incorporate latest advances in research and be disseminated via extension programming to farmers and other land managers.
2	Educational programs for K-12 teachers and youth on soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings.
3	Increased number of farmers and other land managers adopting advances in soil management practices that will build soil quality, increase plant productivity, enhance the beneficial re-use of agricultural, municipal, and industrial by-products (manures, biosolids, residuals) in a variety of land use settings, and prevent nonpoint nutrient pollution of ground and surface waters, particularly for phosphorus and nitrogen.
4	Increased number of farmers and others using soil testing to provide site-specific guidance to increase agricultural profitability, prevent soil loss by erosion, mitigate nonpoint pollution of surface and ground waters, and more efficiently use soils and nutrients in suburban settings.
5	Increased use of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.
6	Soils and Environment: basic research will provide increased understanding of the physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogenic organisms in soils. Applied research will lead to the development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal (phytoremediation) or in-situ degradation or stabilization of pollutants in soils.
7	Environmental Quality: applied research and extension programming will provide guidance on profitable, environmentally sound management of soils at all spatial scales, from the individual field to the watershed. The emphasis will be on cost-effective strategies and management practices that can prevent nonpoint nutrient pollution, soil erosion, and contaminant transport (metals, organics, pathogens) from agriculture and suburbanized landscapes.

Outcome #1

1. Outcome Measures

Soil management programs and best management practices for soil use in agricultural, natural, suburban/urban, and disturbed or contaminated settings will incorporate latest advances in research and be disseminated via extension programming to farmers and other land managers.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 teachers and youth on soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Increased number of farmers and other land managers adopting advances in soil management practices that will build soil quality, increase plant productivity, enhance the beneficial re-use of agricultural, municipal, and industrial by-products (manures, biosolids, residuals) in a variety of land use settings, and prevent nonpoint nutrient pollution of ground and surface waters, particularly for phosphorus and nitrogen.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased number of farmers and others using soil testing to provide site-specific guidance to increase agricultural profitability, prevent soil loss by erosion, mitigate nonpoint pollution of surface and ground waters, and more efficiently use soils and nutrients in suburban settings.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
112	Watershed Protection and Management
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Increased use of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
National science agencies, state and federal agencies interested in links between land use and environmental issues, not-for-profits, the general public.

What has been done
Major ecological observatory established with NSF funding to investigate scientific questions related to climate change effects on soil and water quality at the watershed scale.

Results
UD, in collaboration with the Stroud Water Research Center in Avondale, Pa., received a $4.3 million grant from the National Science Foundation to establish the Christina River Basin as a new "Critical Zone Observatory" for researching questions relating to climate change. The observatory is one of only six in the United States. It is funded through a competitive, five-year grant awarded by the National Science Foundation (NSF) as part of the American Recovery and Reinvestment Act. The effort is led by a UD-CANR faculty member and the research team includes faculty members in the area of plant and soil sciences and bioresources engineering. Using the 565-square-mile Christina River Basin as their laboratory, the scientific team will be working to determine how, and how rapidly, soil erosion and sediment transport through rivers impact the exchange of carbon between the land and the atmosphere, and affect climate. The research team will focus on the sources, transport, and fates of water, sediments, and carbon from uplands to inland waters and from inland waters to the coastal zone. These niche regions will provide the students involved in the program -- eight graduate students from UD and more than a dozen undergraduates at Stroud Water Research Center -- with valuable multi-scale field training.
Cutting-edge technologies will be used for real-time gathering of hydrological, physical, and chemical data. Advances in cyber-infrastructure that seamlessly merges real-time data with state-of-the-art graphics will further establish the new Critical Zone Observatory as a community resource for sharing scientific data and public information.
Field installations and data management will enhance an extensive existing network of stations used for monitoring water flow and water chemistry within the Christina River Basin, including Delaware coastal waters, and will build upon a solid foundation of decades of research conducted by UD, Stroud Water Research Center, and numerous state, federal, and non-governmental agencies. A partnership with NSF's National Center for Airborne Laser Mapping will provide for the collection and processing of extremely detailed and accurate topographic data by Light Detection and Ranging (LIDAR) measurements. Colleagues at the University of California at San Diego, the University of Washington, University of Exeter, and the U.S. Geological Survey also will assist with specific scientific analyses.
Besides serving as a resource to the greater scientific community through open access to data and opportunities for research projects that take advantage of the enhanced monitoring network, the Critical Zone Observatory also will provide outreach to policy makers and the public.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Soils and Environment: basic research will provide increased understanding of the physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogenic organisms in soils. Applied research will lead to the development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal (phytoremediation) or in-situ degradation or stabilization of pollutants in soils.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

133	Pollution Prevention and Mitigation
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Environmental Quality: applied research and extension programming will provide guidance on profitable, environmentally sound management of soils at all spatial scales, from the individual field to the watershed. The emphasis will be on cost-effective strategies and management practices that can prevent nonpoint nutrient pollution, soil erosion, and contaminant transport (metals, organics, pathogens) from agriculture and suburbanized landscapes.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
403	Waste Disposal, Recycling, and Reuse
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

THE SCIENCE AND PRACTICE OF AQUACULTURE

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	25%	25%	25%	25%
302	Nutrient Utilization in Animals	25%	25%	25%	25%
307	Animal Management Systems	40%	40%	40%	40%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	1.0	0.0	2.0
Actual	0.0	0.0	0.0	2.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

In addition to aquaculture research trials that will be conducted at the Delaware State University Aquaculture Research and Demonstration Facility, a series of informational workshops and on-farm demonstration/field days will be held. One-on-one technical assistance will be provided through telephone, e-mail and site visits as needed. Furthermore, research findings will be disseminated through the publication of extension fact sheets, and peer-reviewed publications. A display will be set up at pertinent regional events, including the University of Delaware Coast Day, the Maryland Watermen's East Coast Commercial Fisherman's and Aquaculture Trade Exposition and Delaware Ag Week, to highlight our aquaculture research and extension program activities.

2. Brief description of the target audience

As designed, this program will primarily target existing and perspective aquaculture producers, although the information generated and planned activities will also benefit educators, policy makers and consumers.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	200	350	2000	125
Actual	439	400	2281	1115

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	3	
Actual	0	7	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual
2009	3	7

Output #2

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2009	4	7

Output #3

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2009	3	10

Output #4

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2009	3	6

Output #5

Output Measure

- Number of websites established

Year	Target	Actual
2009	0	1

Output #6

Output Measure

- Number of M.S. students

Year	Target	Actual
2009	{No Data Entered}	5

Output #7

Output Measure

- Number of Grants Submitted

Year	Target	Actual
2009	{No Data Entered}	4

Output #8

Output Measure

- Number of Grants awarded

Year	Target	Actual
2009	{No Data Entered}	4

Output #9

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2009	{No Data Entered}	3

Output #10

Output Measure

- Number of undergraduate researchers

Year	Target	Actual
2009	{No Data Entered}	11

Output #11

Output Measure

- Number of invited presentations

Year	Target	Actual
2009	{No Data Entered}	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased knowledge by the public, the food processing and restaraunt industries, state and regional economic development agencies, and state and federal technical and advisory agencies about the potential economic benefits of expanding aquaculture production.
2	Educate K-12 teachers and youth about aquaculture's role in world food security, the fundamental scientific and technological components of aquaculture production systems, and the financial and marketing aspects of aquaculture as a business.
3	Greater adoption of improved best management practices for recreational and farm ponds to increase profitability and minimize any environmental impacts of aquaculture.
4	Increased ability of aquaculturists to manage production and financial risks.
5	A comprehensive approach to increase and sustain the role of aquaculture in Delaware's economy, including the development of research-based management practices for the production aspects and environmental compatibility of aquaculture, wider use of innovative marketing strategies, and providing ongoing training on the sound business and financial management skills needed by aquaculturists

Outcome #1

1. Outcome Measures

Increased knowledge by the public, the food processing and restaraunt industries, state and regional economic development agencies, and state and federal technical and advisory agencies about the potential economic benefits of expanding aquaculture production.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educate K-12 teachers and youth about aquaculture's role in world food security, the fundamental scientific and technological components of aquaculture production systems, and the financial and marketing aspects of aquaculture as a business.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Greater adoption of improved best management practices for recreational and farm ponds to increase profitability and minimize any environmental impacts of aquaculture.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
307	Animal Management Systems
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased ability of aquaculturists to manage production and financial risks.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

A comprehensive approach to increase and sustain the role of aquaculture in Delaware's economy, including the development of research-based management practices for the production aspects and environmental compatibility of aquaculture, wider use of innovative marketing strategies, and providing ongoing training on the sound business and financial management skills needed by aquaculturists

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}